

KENWOOD

SERVICE MANUAL

SM-220



STATION MONITOR

SAFETY NOTICE

The following explicit definitions apply in this manual:

NOTE If disregarded, inconvenience only — no risk of equipment damage or personal injury.

CAUTION Equipment damage may occur, but not personal injury.

WARNING Personal injury may occur — DO NOT DISREGARD!

WARNING

HIGH VOLTAGES PRESENT

Observe all standard safety procedures regarding high RF, AC, and DC potentials.

HIGH VACUUM CRT

The CRT (cathode ray tube) contained in this instrument is a high vacuume device, breakage of which may cause high velocity scattering of glass particles. Rough handling of the instrument, and especially the CRT, is to avoided.

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SECTION 1. SPECIFICATIONS

CRT75ARB31

| | |
|----------------|------------|
| Phosphor | B31 |
| Colour | Blue-Green |

TRANSMIT SIGNAL MONITOR TERMINAL

| | |
|-----------------------|-------------------------|
| Frequency range | 1.8 ~ 150 MHz |
| Maximum power | 1.8 ~ 54 MHz (2 kW/PEP) |
| | 150 MHz (200 W/PEP) |

| | |
|------------------------------|----------------------------------|
| SWR | 1.2 or less |
| Deflection sensitivity | More than 1 DIV at 2 W/PEP input |
| Attenuator | 6 steps |

TRAPEZOID WAVEFORM OBSERVATION

| | |
|---------------------------------------|--------------|
| Frequency range | 1.8 ~ 30 MHz |
| Maximum power at DRIVE terminal | 100 W/PEP |
| SWR | 1.2 or less |

TWO-TONE GENERATOR

| | |
|----------------------------|-------------------------------------|
| Oscillator frequency | 1,000 Hz 1575 Hz or both switchable |
| Output voltage | 10 mV/50k Ω (at TWO TONE) |

PAN DISPLAY

| | |
|------------------------------|--|
| Adaptor name | BS-5 (TS-520 series), BS-8 (TS-820 series) |
| Input center frequency | 3,395 MHz (BS-5), 8,830 MHz (BS-8) |
| IF frequency | 455 kHz |
| IF bandwidth | More than 1 kHz (-6 dB) |
| Input sensitivity | More than 20 dB μ /DIV |
| Scan width | \pm 20 kHz, \pm 100 kHz, selectable |

HORIZONTAL AMPLIFIER

| | |
|---------------------------------|---|
| Gain adjustment | 100B (Approximate) |
| Deflection sensitivity | More than 300 mV/DIV |
| Frequency response | DC-250 kHz or greater (EXT GAIN at MAX) |
| | DC-40 kHz (EXT GAIN at 1/2) |
| Input resistance/capacity | 1 M Ω (\pm 20%), 40 pF or less (SYNC switch at INT) |
| Attenuator | Fully variable to 0 |
| Max. input voltage | 100 Vp-p |

SWEEP CIRCUIT

| | |
|-----------------------|--|
| Sweep frequency | 10 Hz ~ 100 kHz (in 4 ranges, variable) |
| Sweep linearity | Better than 5% |
| Sync system | Synchronized sweep, internal negative sync and external sync |
| Sync amplitude | Internal More than 1 DIV on CRT |
| | External ... More than 2 Vp-p |

VERTICAL AMPLIFIER

| | |
|---------------------------------|--------------------------------|
| Deflection sensitivity | More than 20 mV/DIV |
| Frequency response | 2 Hz ~ 10 MHz (-3 dB) |
| Input resistance/capacity | 1 M Ω , 40 pF |
| Overshoot | Less than 5% |
| Attenuator | 1, 1/10, 1/100 and GND/MONITOR |
| | (Error between steps: 5% max.) |
| Max. input voltage | 300V (DC+AC peak) or 600 Vp-p |

| | |
|--------------------|----------------------------------|
| POWER SUPPLY | AC 117V \pm 10%, 50/60 Hz, 20W |
|--------------------|----------------------------------|

| | |
|------------------|---|
| DIMENSIONS | 215(W) \times 153(H) \times 335(D) mm |
| Weight | 5 kg |

ACCESSORIES SUPPLIED

| | |
|------------------------------------|---|
| Instruction book | 1 |
| VHF type cable | 1 |
| Tone output cable | 1 |
| Auxiliary feet (with screws) | 2 |
| Warranty card | 1 |

Specifications are subject to change without notice due to technical improvements.

SECTION 2. FEATURES

1. The SM-220 Station Monitor is specially designed for the TS-820 and TS-520 series SSB transceiver.
2. The SM-220 functions as monitor scope, oscilloscope and two-tone oscillator. An optional Pan Display scope function is available.
3. Transmit waveform from 1.8 ~ 150 MHz can be observed with the monitor scope. Applicable power levels: 2KW PEP to 54 MHz, 200W PEP to 150 MHz. Drive input/output terminals allow trapezoid waveform observation of a linear amplifier.
4. Oscilloscope sensitivity is 20 mV/div (min), and bandwidth is 2 Hz ~ 10 MHz (min). Further, the IF waveform of the TS-820/S receiver section can be directly observed from the IF-OUTPUT terminal.
5. Two Wien bridge oscillators generate 1000 Hz and 1575 Hz tone, available individually or simultaneously.
6. Optional Pan Display units available:
The BS-8 for TS-820 series transceivers.
The BS-5 for TS-520 series transceivers.
7. Horizontal trace tilt can be adjusted from the rear of the unit without removing the case.
8. The blue-green phosphor (B31) CRT assures excellent brightness and contrast.

SECTION 3. CRT SPECIFICATIONS

Dimensions

| | |
|--------------------|------------|
| Total length..... | 250 ± 6 mm |
| Max. diameter..... | 76 ± 2 mm |

Heater

| | |
|--------------|------|
| Voltage..... | 6.3V |
| Current..... | 0.3A |

Maximum

| | |
|----------------------------|-------|
| Plate 2 voltage (Eb2)..... | 2750V |
| Grid 2 voltage (Ec2)..... | 2750V |

Operating Characteristics

| | |
|-------------------------------|-------------------|
| Plate 2 voltage (Eb2)..... | 1500V |
| Focus voltage (Eb1)..... | 75 ~ 300V |
| Grid 2 voltage (Ec2)..... | 1500V |
| Blanking voltage (Ec0)..... | -28.5 ~ -67.5V |
| X-axis deflection factor..... | 23.1 ~ 29.1VDC/cm |
| X-axis deflection factor..... | 13.7 ~ 18.2VDC/cm |

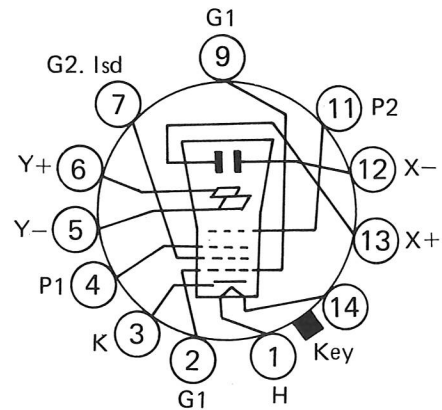


Fig. 3-1 75ARB31 Basing

SECTION 4. BLOCK DIAGRAM

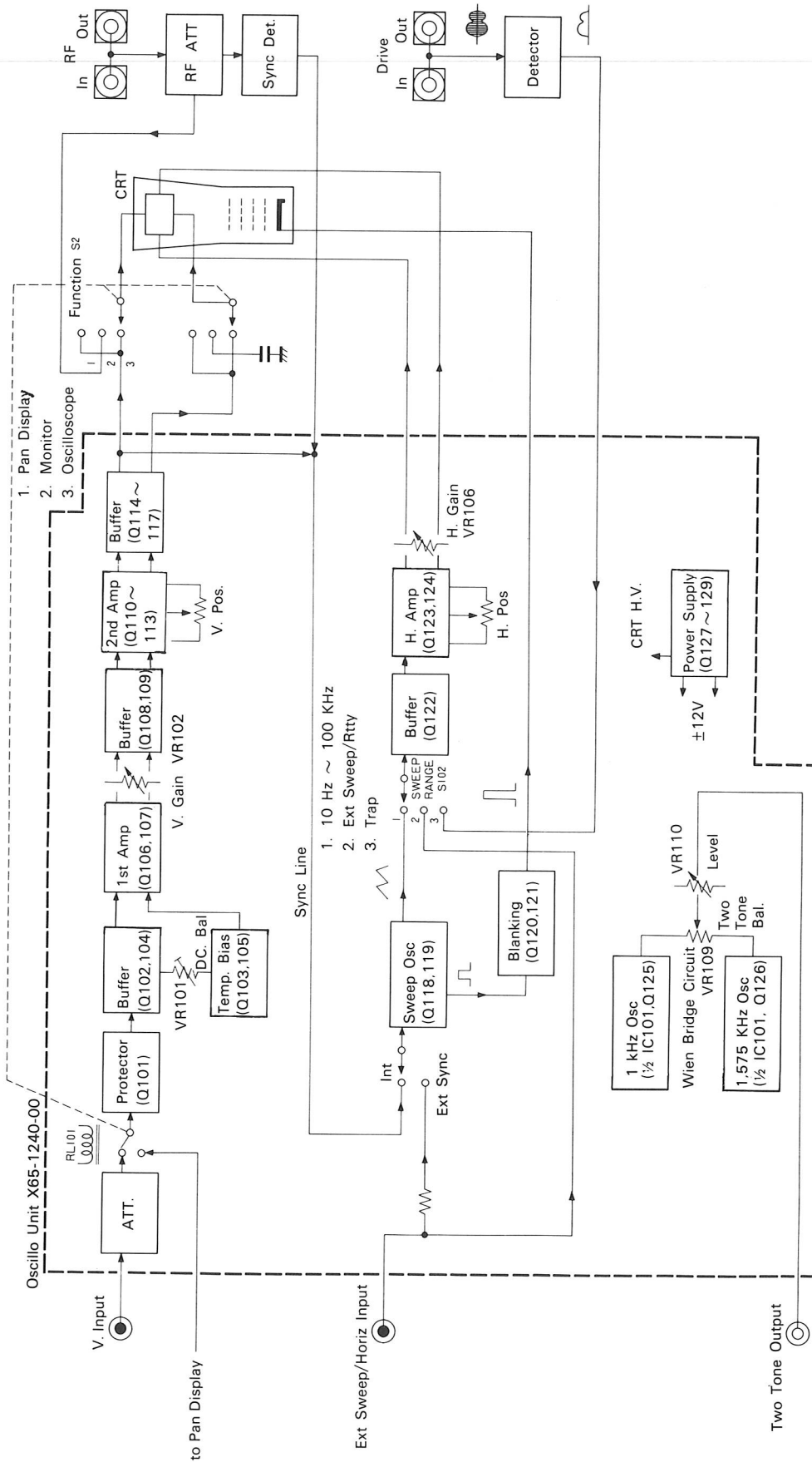


Fig. 4-1 SM-220 (Block Diagram)

SECTION 5. CIRCUIT DESCRIPTION

1. THEORY OF OSCILLOSCOPE DISPLAY

Fig. 5-1 shows the principle of oscilloscope display. Electrons emitted from the cathode of the CRT and electrostatically deflected by the X and Y deflection plates. When a signal to be observed (a sine wave in this figure) is applied to the Y deflection plates and a saw tooth voltage is applied to the X deflection plates, the high voltage accelerated electron beam strikes the phosphor screen and the waveform (as shown in Fig. 5-2 appears on the screen.

2. VERTICAL CIRCUIT

When the SM-220 is used as an oscilloscope, signal is applied to the V. INPUT and may be divided 1/1, 1/10 or 1/100 by the V. ATTENUATOR, according to the amplitude of the signal. TC101 and TC102 provide compensation of the high frequency signal components, which are lowered by the attenuator input capacitance, and stray capacitance of the amplifiers. The signal is applied to the protection circuit Q101, and the gate of Q102 via a switching relay. The gate current of Q101 begins to flow when signal peak voltage becomes less than $-13V$, so that Q102 is protected from breakdown.

A buffer consisting of Q102 and Q104 is combination source follower and emitter follower, so a high input impedance and a low output impedance are achieved. Q106 and Q107 form a differential amplifier, the gain of which can be varied in the range of 22 dB by VR102 (V. GAIN), bridged between the two emitters. Q103 and Q104 bias the amplifiers against temperature change. VR101 adjusts the DC Balance between the emitters of Q104 and Q105. Of the emitter voltages

are unbalanced, this difference is amplified and as the V. GAIN is adjusted the trace moves from the center of the screen. The signal, amplified by Q106 and Q107, 1st amplifier is applied to the emitter follower Q108 and Q109, and then applied to the 2nd amplifier, Q110 ~ 113. The 2nd amplifier is cascaded, and exhibits good high-frequency characteristics. TC103 corrects high-frequency response, and VR103 adjusts the Vertical Position. Q114 through Q117 form a complementary emitter follower amplifier, whose low output impedance decreases the affects of deflection plate high frequency loading. When the SM-220 is used as an oscilloscope, this emitter follower output is applied to the Y deflection plate of the CRT.

3. HORIZONTAL CIRCUIT

The horizontal circuit consists of a Sweep Oscillator generating saw tooth voltage, and a Horizontal Amplifier. To make the display stationary on the screen, the sweep frequency must be $1/N$ of the input signal frequency (as shown in Fig. 1, $N = 2$). That is, the sweep must be synchronized with the input signal. For this purpose, the sync signal is picked-off the vertical amplifiers Q114 ~ 117, and applied to the sweep oscillator Q118, Q119. The S4b SYNC/MARKER switch INT (internal or EXT (external) sync signal. When the SM-220 is used as an oscilloscope with INT sync, the sweep synchronizes with the V. INPUT signal. When used as a MONITOR, the sweep is synchronized with the modulated transceiver output. In the EXT position, the sweep synchronizes with a signal applied to the H. INPUT/EXT. SYNC terminal.

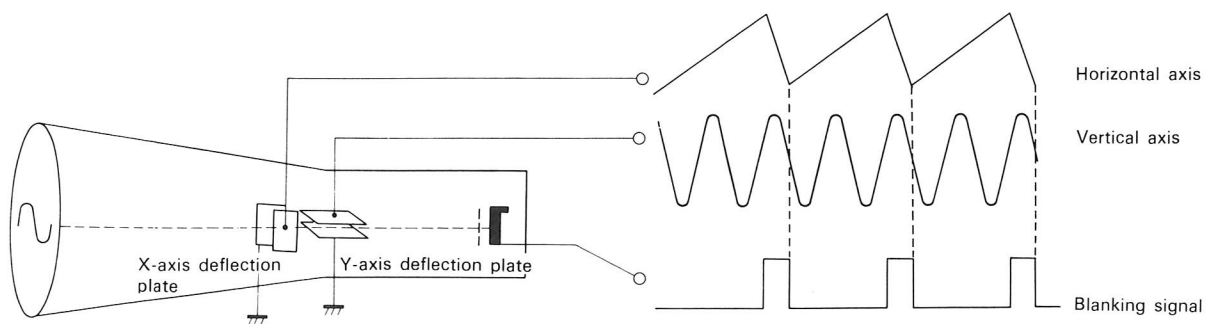
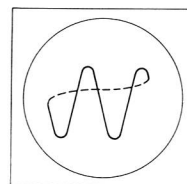


Fig. 5-1 Oscilloscope theory



Broken line doesn't appear because of blanking signal.

Fig. 5-2 Waveform on screen

SECTION 5. CIRCUIT DESCRIPTION

Saw tooth voltage generated by the sweep oscillator is amplified by the horizontal amplifier Q112 ~ 124, and applied to the X deflection plates. When the SWEEP RANGE selector is placed in the EXT position, the H. INPUT/EXT SYNC signal is applied to the horizontal amplifier after attenuation by the SWEEP VAN/EXT. GAIN control. VR-106 (H. GAIN) sets varies the horizontal amplifier gain so the trace extends fully across the screen.

4. MONITOR CIRCUIT

With the function switch in the MONITOR position, transmitted RF passes through the RF-IN/OUT circuit, is RF. attenuated and applied to the Y deflection plates. The attenuated signal is also detected and used as sync reference. When Trapezoid waveform is

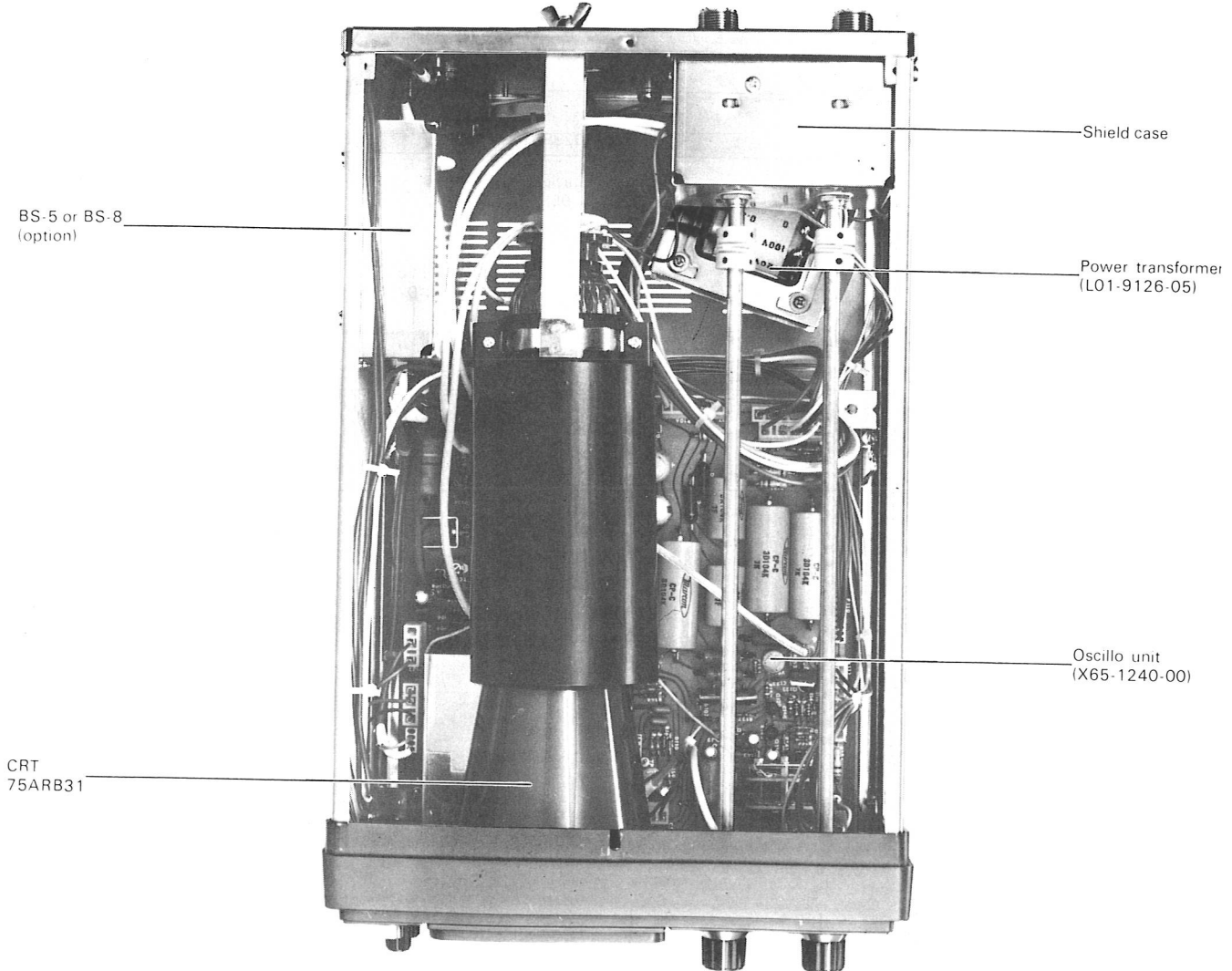
observed, modulated RF passing through the DRIVE IN/OUT circuit is detected and then applied to the horizontal amplifier.

5. TWO-TONE OSCILLATOR

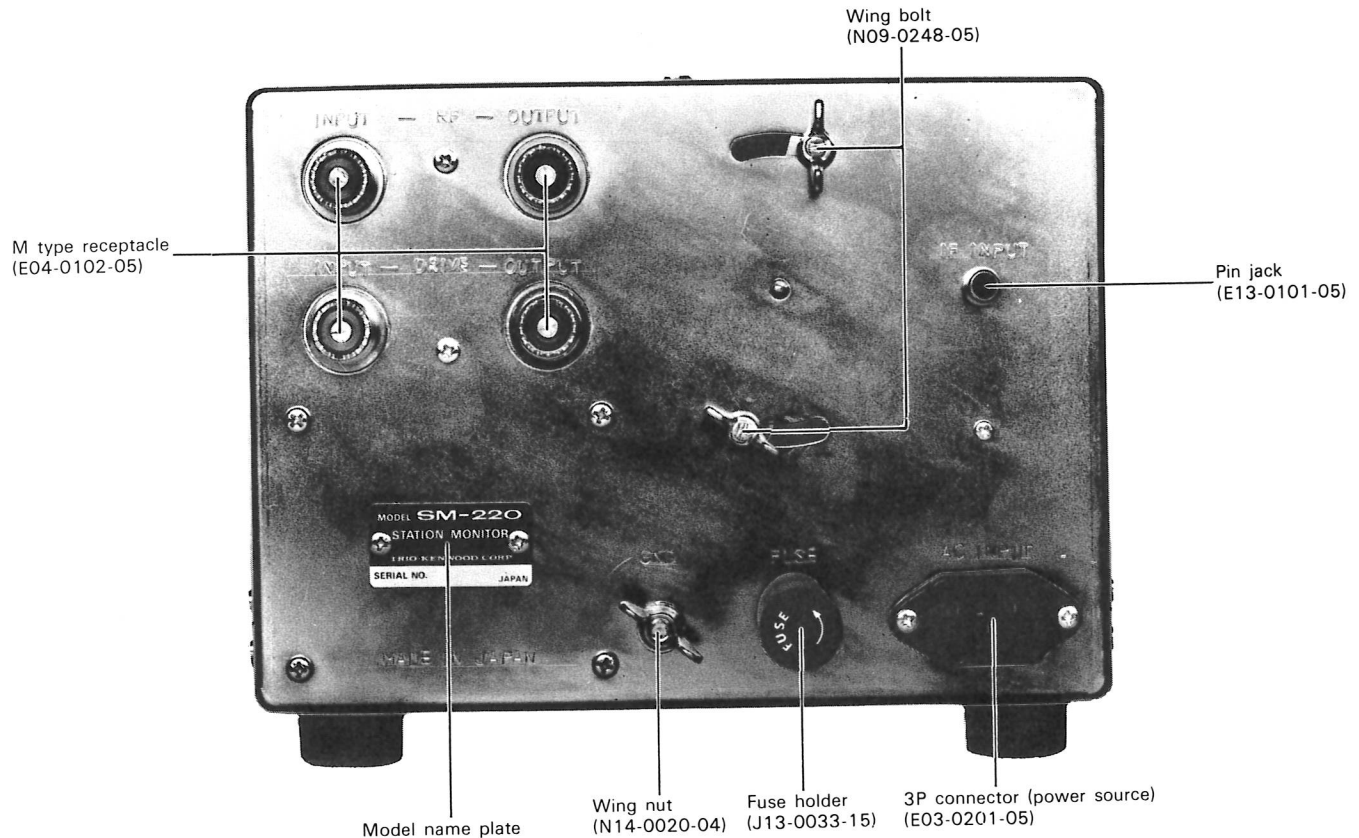
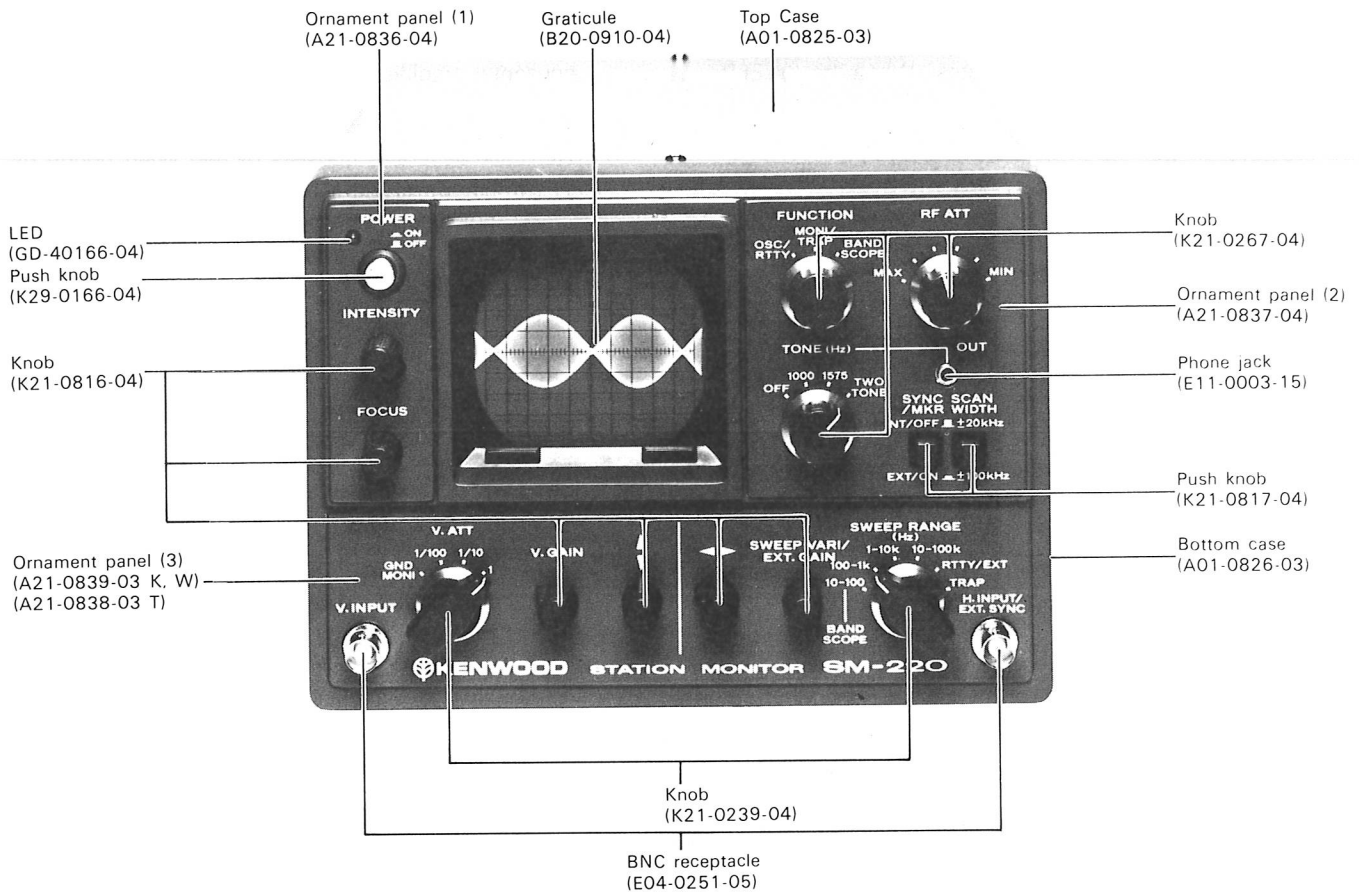
The tone generator consists of two Wien bridge oscillator operating at 1 kHz and 1,575 kHz. Q125 and Q126 act as feedback resistors to prevent temperature variation output fluctuation. VR-109 is the Two-Tone Balance adjustment and VR-110 adjusts the Output Level.

6. POWER SUPPLY

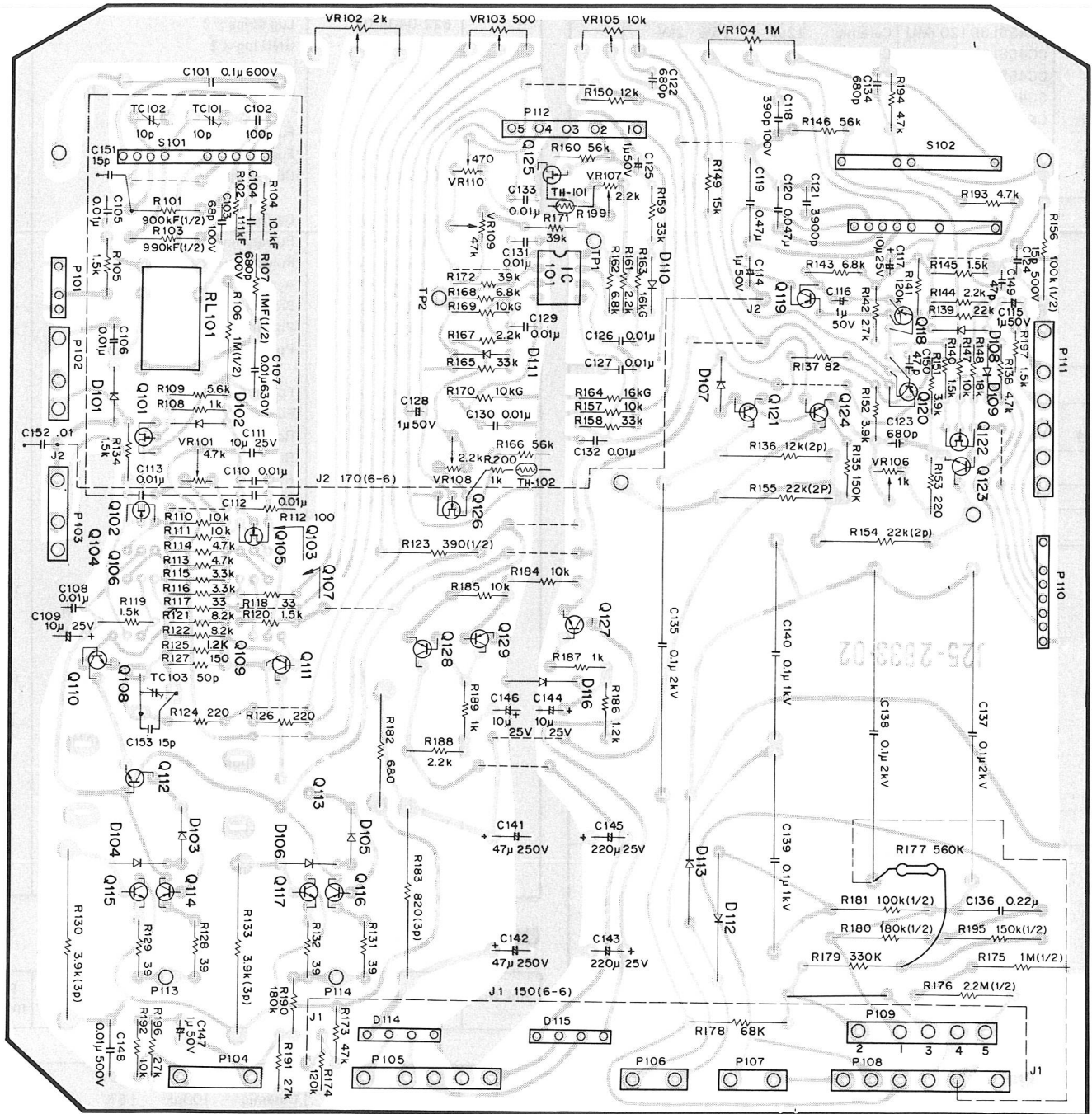
The Power Supply provides regulated +12V and -13V, +150V for the final amplifiers, and -1300V for the CRT.



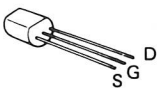
SECTION 6. VIEWS



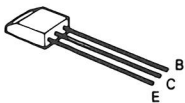
SECTION 7. PRINTED CIRCUIT BOARDS



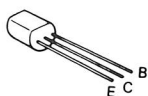
2SK30A(O)
2SK30A(O)(DSS)
2SK30A(GR)



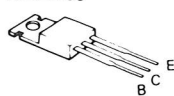
2SC535(B)



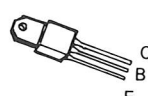
2SC1360



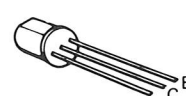
2SC1419C
2SA755C
2SC1569



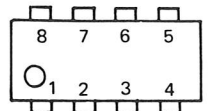
2SA818Y
2SC1628Y



2SA495



NJM4558D



SECTION 8. PARTS LIST

GENERAL (Y71-1100-00)

☆ : New parts K U.S.A. W Europe. T Britain

| Ref. No. | Parts No. | Description | Re- marks |
|--------------------------|----------------|--------------------------------------|--------------|
| CAPACITOR | | | |
| C1,2 | CC45SL3D120JMU | Ceramic 12pF ±5% 2kV | |
| C3 | CC45SL2H050D | Ceramic 5pF ±0.5pF 500V | |
| C4 | CC45SL2H030D | Ceramic 3pF ±0.5pF 500V | |
| C5 | CC45SL2H010D | Ceramic 1pF ±0.5pF 500V | |
| C6~7 | CK45D2H103D | Ceramic 0.01μF ±20% | |
| C8 | CK45D2H222M | Ceramic 0.0022μF ±20% | |
| C9,10 | C90-0300-05 | Ceramic 470pF | |
| C11 | C91-0023-05 | Ceramic 0.01μF AC250V | |
| RESISTOR | | | |
| R1 | RS14AB3F561J | Metal film 560Ω ±5% 3W | |
| R2 | RS14AB3D103J | Metal film 10kΩ ±5% 2W | |
| R3 | RD14BY2H222J | Carbon 2.2kΩ ±5% 1/2W | |
| R4 | RS14AB3D103J | Metal film 10kΩ ±5% 2W | |
| R5 | RD14BY2H222J | Carbon 2.2kΩ ±5% 1/2W | |
| R6,7 | RD14BY2H105J | Carbon 1MΩ ±5% 1/2W | |
| SEMICONDUCTOR | | | |
| D1 | V11-7200-10 | LED <Red> | |
| D2~4 | V11-0370-05 | Diode 1S1587 | |
| CRT | | | |
| CRT | | CRT 75ARB31 | |
| VR/SW/TRANSFORMER | | | |
| VR1 | R05-8501-05 | Variable resistor 1MΩ <FOCUS> | ☆ |
| VR2 | R05-8501-05 | Variable resistor 1MΩ <INTENSITY> | ☆ |
| S1 | S39-2006-05 | Push switch <POWER> | |
| S2 | S01-1508-05 | Rotary switch <FUNCTION> | ☆ |
| S3 | S01-1501-05 | Rotary switch <RF ATT> | |
| S4a | S42-2503-06 | Push switch <SCAN WIDTH> | ☆ |
| S4b | S42-2503-05 | Push switch <SYNC MARKER> | ☆ |
| S5 | S01-1506-05 | Rotary switch <TONE> | ☆ |
| T1 | L01-9126-05 | Power transformer | |
| MISCELLANEOUS | | | |
| | A01-0825-03 | Top case | ☆ |
| | A01-0826-03 | Bottom case | ☆ |
| | A20-2724-03 | Panel ass'y T | ☆ |
| | A20-2725-03 | Panel ass'y K, W | ☆ |
| | A20-2726-02 | Mold Panel | ☆ |
| | A21-0836-04 | Ornament panel (1) | ☆ |
| | A21-0837-04 | Ornament panel (2) | ☆ |
| | A21-0839-03 | Ornament panel (3) K, W | ☆ |
| | A21-0838-03 | Ornament panel (3) T | ☆ |
| | B07-0702-04 | Escutcheon (Push switch) × 2 | ☆ |
| | B09-0011-04 | Rubber cap × 3 | |
| | B20-0910-04 | Graticule | ☆ |
| | B30-0707-05 | Lamp ass'y | ☆ |
| | B46-0007-00 | Warranty card | |
| | B50-2856-00 | Operating manual K, W | ☆ |
| | B50-2857-00 | Operating manual T | ☆ |
| | D21-0902-04 | Shaft | ☆ |
| | D22-0402-05 | Universal coupling | |
| | E01-1403-05 | CRT socket | |
| — | E03-0201-05 | 3P connector (power source) | |
| — | E04-0102-05 | M type receptacle × 4 | |
| — | E04-0251-05 | BNC receptacle × 2 | |
| — | E11-0003-15 | Phone jack | |

| Ref. No. | Parts No. | Description | Re- marks |
|----------|-------------|--|--------------|
| — | E13-0101-05 | Pin jack | |
| — | E22-0405-05 | Lug strips × 2 | |
| — | E23-0015-04 | GND lug × 2 | |
| — | E30-1818-05 | JIS cord (Power cord) K | |
| — | E30-1819-05 | CEE cord (Power cord) W, T | |
| | F05-5013-05 | Fuse 0.5A × 2 K | |
| | F05-3011-05 | Fuse 0.3A × 2 W, T | |
| | F11-0920-04 | CRT shield | ☆ |
| | H01-2839-04 | Carton | ☆ |
| | H01-2805-02 | Polystyrene foam cushion [Front] | ☆ |
| | H01-2806-02 | Polystyrene foam cushion [Rear] | ☆ |
| | H19-0503-03 | Accessory box | ☆ |
| | H20-1709-04 | Protective cover | ☆ |
| | H25-0029-04 | Polyethylene bag | ☆ |
| | H25-0007-14 | Polyethylene bag | |
| | J02-0049-14 | Foot × 6 | |
| | J13-0033-15 | Fuse holder | |
| | J32-1030-14 | Round boss × 2 | |
| | J42-0002-05 | Rubber bush | |
| | J42-0021-05 | Rubber bush × 2 | |
| | J61-0053-05 | Board support × 2 | |
| | K21-0267-04 | Knob × 3 TONE, RF ATT, FUNCTION | |
| | K21-0816-04 | Knob × 6 INTENSITY, FOCUS, V.GAIN, ◀▶ POSITION, ⬇ POSITION, SWEEP VARI/EXT GAIN | ☆ |
| | K21-0817-04 | Knob (push) × 2 SCAN WIDTH, MARKER/SYNC INT-EXT | ☆ |
| | K23-0239-04 | Knob × 2 V. ATT, SWEEP RANGE | |
| | K29-0802-04 | Knob (push) POWER | |
| | X42-1120-10 | Coaxial cable ass'y | |
| | X65-1240-00 | OSCILLO unit | |
| | X67-1020-00 | BNC cord | |
| | X67-1070-00 | Two tone output cord | |

OSCILLO UNIT (X65-1240-00)

| Ref. No. | Parts No. | Description | Re- marks |
|------------------|--------------|------------------------|--------------|
| CAPACITOR | | | |
| C101 | C90-0021-05 | Metal film 0.1μF 600V | ☆ |
| C102 | CC45SL1H101J | Ceramic 100pF ±5% | |
| C103 | CM93BD2A680J | Mica 68pF ±5% | |
| C104 | CM93BD2A681J | Mica 680pF ±5% | |
| C105 | CK45D1H103M | Ceramic 0.01μF ±20% | |
| | 106 | | |
| C107 | C91-0502-05 | Metal film 0.01μF 630V | ☆ |
| C108 | CK45D1H103M | Ceramic 0.01μF ±20% | |
| C109 | CE04W1E100 | Electrolytic 10μF 25V | |
| C110 | CK45D1H103M | Ceramic 0.01μF ±20% | |
| C111 | CE04W1E100 | Electrolytic 10μF 25V | |
| C112 | CK45D1H103M | Ceramic 0.01μF ±20% | |
| | 113 | | |
| C114~ | CE04BW1H010M | Electrolytic 1μF 50V | |
| | 116 | | |
| C117 | CE04W1E100 | Electrolytic 10μF 25V | |

SECTION 8. PARTS LIST

| Ref. No. | Parts No. | Description | Re- marks |
|-----------------|---------------|----------------------------|--------------|
| C118 | CM03BD2A391J | Mica 390pF ±5% | |
| C119 | CQ93M1H474K | Mylar 0.47μF ±10% | |
| C120 | CQ93M1H473K | Mylar 0.047μF ±10% | |
| C121 | CQ93M1H392K | Mylar 3900pF ±10% | |
| C122, 123 | CK45D1H681M | Ceramic 680pF ±20% | |
| C124 | CE04W1C470 | Electrolytic 47μF 16WV | |
| C125 | CE04BW1H010M | Electrolytic 1μF 50V | |
| C126, 127 | CQ93M1H103J | Mylar 0.01μF ±5% | |
| C128 | CE04BW1H010M | Electrolytic 1μF 50V | |
| C129, 130 | CQ93M1H103J | Mylar 0.01μF ±5% | |
| C131~133 | CK45D1H103M | Ceramic 0.01μF ±20% | |
| C134 | CK45D1H681M | Ceramic 680pF ±20% | |
| C135 | C91-0509-05 | Oil 0.1μF 2kV | |
| C136 | CQ93M1H224K | Mylar 0.22μF ±10% | |
| C137, 138 | C91-0509-05 | Oil 0.1μF 2kV | |
| C139, 140 | C91-0506-05 | Oil 0.1μF 1kV | |
| C141, 142 | CE04W2E470 | Electrolytic 47μF 250WV | |
| C143 | CE04W1E221 | Electrolytic 220μF 25WV | |
| C144 | CE04W1E100 | Electrolytic 10μF 25WV | |
| C145 | CE04W1E221 | Electrolytic 220μF 25WV | |
| C146 | CE04W1E100 | Electrolytic 10μF 25WV | |
| C147 | CE04BW1H010M | Electrolytic 1μF 50WV | |
| C148 | CK45D2H103M | Ceramic 0.01μF ±20% | |
| C149, 150 | CC45SL1H470J | Ceramic 47pF ±5% | |
| C151 | CC45SL2H150J | Ceramic 15pF ±15% | |
| C152 | CK45D1H103M | Ceramic 0.01μF ±20% | |
| C153 | CC45SL1H150J | Ceramic 15pF ±5% | |
| RESISTOR | | | |
| R101 | RN14BK2H9003F | Metal film 199kΩ ±1% 1/2W | ☆ |
| R102 | RN14BK2E1113F | Metal film 111kΩ ±1% 1/4W | ☆ |
| R103 | RN14BK2H9903F | Metal film 990kΩ ±1% 1/2W | ☆ |
| R104 | RN14BK2E1012F | Metal film 10.1kΩ ±1% 1/4W | ☆ |
| R105 | RD14BB2E152J | Carbon 1.5kΩ ±5% 1/4W | |
| R106 | RD14BY2H105J | Carbon 1MΩ ±5% 1/2W | |
| R107 | RD14BK2H1004F | Carbon 1MΩ ±1% 1/2W | |
| R108~122 | RD14BB2E000J | Carbon 000Ω ±5% 1/4W | |
| R123 | RD14BY2H391J | Carbon 390Ω ±5% 1/2W | |
| R124~129 | RD14BB2E000J | Carbon 000Ω ±5% 1/4W | |
| R130 | RS14GB3F392J | Metal film 3.9kΩ ±5% 3W | ☆ |
| R131~132 | RD14BB2E390J | Carbon 39Ω ±5% 1/4W | |
| R133 | RS14GB392J | Metal film 3.9kΩ ±5% 3W | ☆ |
| R134~135 | RD14BB2E000J | Carbon 000Ω ±5% 1/4W | |
| R136 | RS14GB3D123J | Metal film 12kΩ ±5% 1/2W | ☆ |
| R137~153 | RD14BB2E000J | Carbon 000Ω ±5% 1/4W | |
| R154~155 | RS14GB3D000J | Metal film 000Ω ±5% 2W | ☆ |
| R156 | RD14BY2H104J | Carbon 100kΩ ±5% 1/2W | |
| R157~162 | RD14BB2E000J | Carbon 000Ω ±5% 1/4W | |
| R163~164 | RN14BK2E000G | Metal film 000Ω ±2% 1/4W | ☆ |
| R165 | RN14BB2E333J | Carbon 33kΩ ±5% 1/4W | |
| R166~168 | RD14BB2E000J | Carbon 000Ω ±5% 1/4W | |

| Ref. No. | Parts No. | Description | Re- marks |
|-----------------------|--------------|--|--------------|
| R169~170 | RD14BK2E000J | Carbon 000Ω ±5% 1/4W | |
| R171~174 | RD14BB2E000J | Carbon 000Ω ±5% 1/4W | |
| R175~181 | RD14BY2H000J | Carbon 000Ω ±5% 1/2W | |
| R182 | RS14GB3D122J | Metal film 1.2kΩ ±5% 2W | ☆ |
| R183 | RS14GB3F821J | Metal film 820Ω ±5% 3W | ☆ |
| R184~194 | RD14BB2E000J | Carbon 000Ω ±5% 1/4W | |
| R195 | RD14BY2H154J | Carbon 150kΩ ±5% 1/2W | |
| R196~197 | RD14BB2E000J | Carbon 000Ω ±5% 1/4W | |
| | R92-0150-05 | Jumper resistor × 17 | |
| SEMICONDUCTOR | | | |
| IC101 | V30-0217-05 | IC NJM4558D | ☆ |
| Q101 | V09-0056-05 | FET 2SK30A-0 | |
| Q102~103 | V09-9981-05 | FET 2SK30A-0 (Idss) | |
| Q104~109 | V03-0098-05 | Transistor 2SC535B | |
| Q110~111 | V03-1360-06 | Transistor 2SC1360 | ☆ |
| Q112~113 | V03-1569-06 | Transistor 2SC1569 | ☆ |
| Q114 | V01-0153-06 | Transistor 2SA818-Y | |
| Q115 | V03-0401-05 | Transistor 2SC1628-Y | |
| Q116 | V01-0153-05 | Transistor 2SA818-Y | |
| Q117 | V03-0401-05 | Transistor 2SC1628-Y | |
| Q118~120 | V01-0037-05 | Transistor 2SA496-Y | |
| Q121 | V03-1569-06 | Transistor 2SC1569 | ☆ |
| Q122 | V09-0056-05 | FET 2SK30A-0 | |
| Q123, 124 | V03-1569-06 | Transistor 2SC1569 | ☆ |
| Q125, 126 | V09-0060-05 | FET 2SK30A-GR | |
| Q127 | V03-0343-05 | Transistor 2SC1419C | |
| Q128 | V01-0114-05 | Transistor 2SA755C | |
| Q129 | V01-0037-05 | Transistor 2SA495Y | |
| D101~107 | V11-0076-05 | Diode 1S1555 | |
| D108 | V11-0051-05 | Diode 1N60 | |
| D109~111 | V11-0076-05 | Diode 1S1555 | |
| D112~113 | V11-0288-05 | High pressure diode HVT-22Z-3 | |
| D114~115 | V11-0410-05 | Diode (bridge) S1QB60 | |
| D116 | V11-0249-05 | Zener diode WZ-120 | |
| TH101, 102 | V22-0033-05 | Thermister SDT-100 | |
| SWITCH/TRIMMER | | | |
| VR101 | R12-1004-05 | Semi-fixed resistor 4.7kΩ < DC.BAL > | |
| VR102 | R03-1020-05 | Semi-fixed resistor 2kΩ (C) < V.GAIN > | |
| VR103 | R01-0505-05 | Semi-fixed resistor 500Ω (B) < V.POS. > | |
| VR104 | R03-8050-05 | Semi-fixed resistor 1MΩ (B) < SWEEP VAR. H. GAIN > | |
| VR105 | R01-2503-05 | Semi-fixed resistor 10kΩ (B) < H.POS. > | |

SECTION 8. PARTS LIST

| Ref. No. | Parts No. | Description | Re- marks |
|----------------------|-------------|--|--------------|
| VR106 | R12-1002-05 | Semi-fixed resistor 1k Ω < H. GAIN > | |
| VR107 ~ 108 | R12-1003-05 | Semi-fixed resistor 2.2k Ω | |
| VR109 | R12-3004-05 | Semi-fixed resistor 470k Ω | |
| VR110 | R12-0003-05 | Semi-fixed resistor 470 Ω | |
| TC101, 102 | C05-0404-05 | Trimmer (Ceramic) 10pF | |
| TC103 | C05-0029-15 | Trimmer (Ceramic) 50pF | |
| SWTICH/RELAY | | | |
| S101 | S01-1507-05 | Rotary switch <V.ATT> | ☆ |
| S102 | S01-2505-05 | Rotary switch <SWEEP RANGE> | ☆ |
| PL101 | S51-1506-05 | Relay | ☆ |
| MISCELLANEOUS | | | |
| | E23-0046-04 | Terminal \times 6 | |
| | E23-0508-04 | Terminal [test point] \times 2 | |

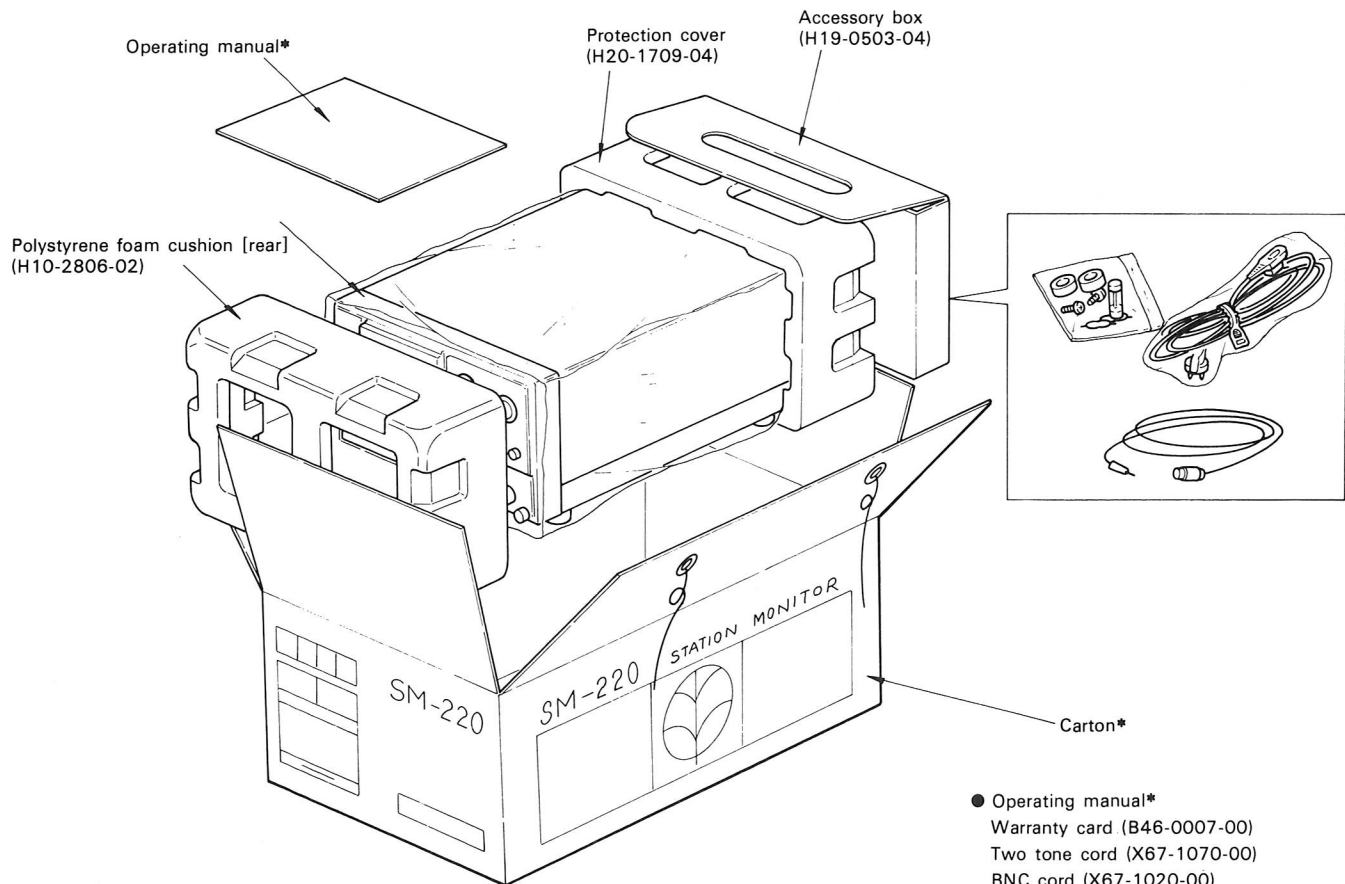
BNC CORD (CA-41) (X67-1020-00)

| Ref. No. | Parts No. | Description | Re- marks |
|----------|-------------|------------------------|--------------|
| — | E05-0357-05 | BNC plug | ☆ |
| — | E91-0003-05 | Alligator clip (black) | |
| — | E91-0004-05 | Alligator clip (Red) | |
| — | O60-0002-05 | Coaxial cable | |
| — | H25-0016-00 | Polyethylene bag | |

TWO TONE CORD (X67-1070-00)

| Ref. No. | Parts No. | Description | Re- marks |
|----------|-------------|-------------|--------------|
| — | E07-0403-05 | Round plug | |
| — | E12-0001-05 | Phone plug | |
| — | J42-0506-04 | Rubber tube | |

SECTION 9. PACKING



- Operating manual*
- Warranty card (B46-0007-00)
- Two tone cord (X67-1070-00)
- BNC cord (X67-1020-00)
- Power cord (supplied)*
- Coaxial cable Ass'y (X42-1120-10)
- Polyethylene bag
- 1. Foot (w/screw) (J02-0049-14) \times 2
- 2. Fuse (spare) (F05-5013-05)
- 3. Resistor 10k Ω , 150 Ω

* See parts list

SECTION 10. DISASSEMBLY

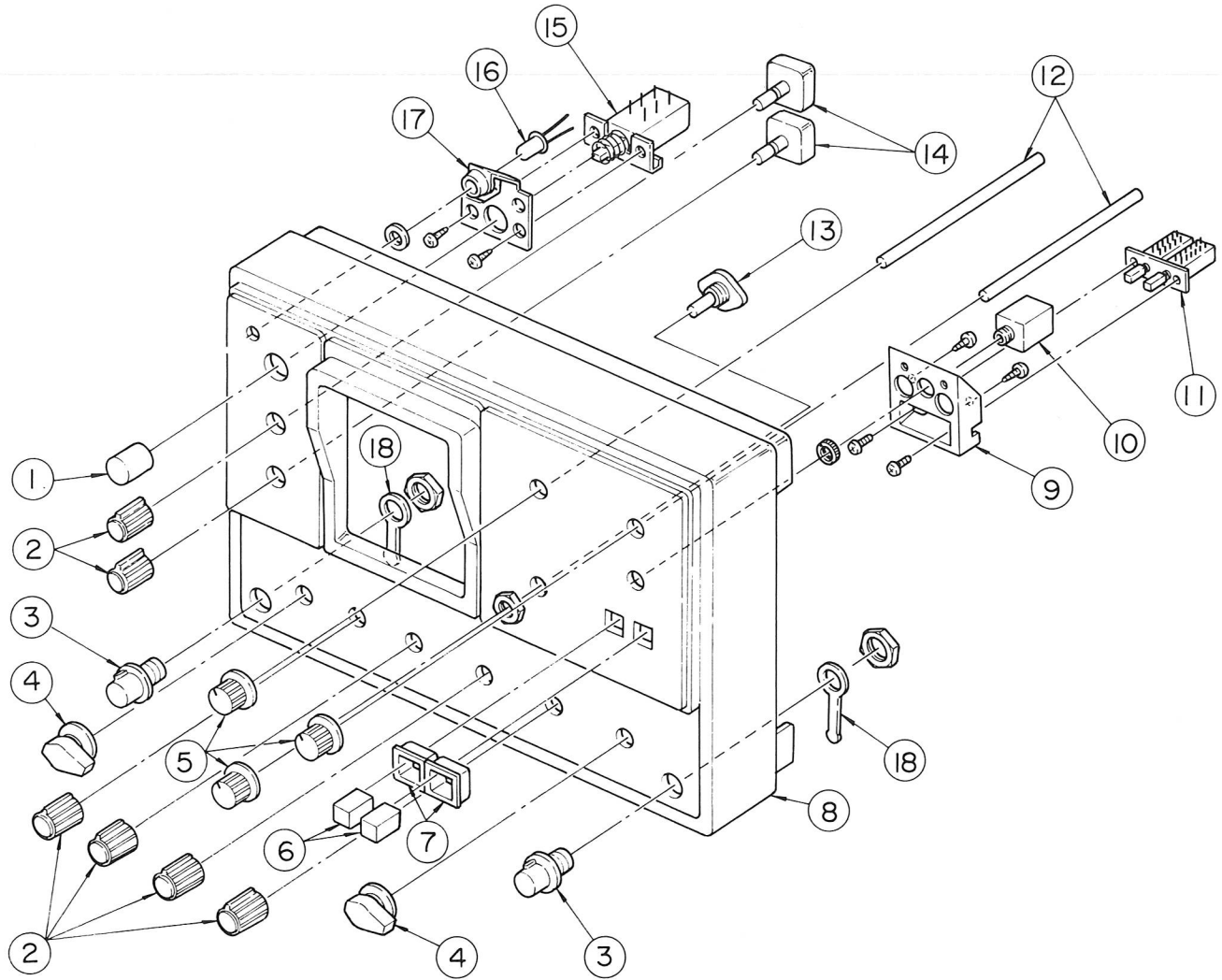


Fig. 10-1 Front Panel Disassembly

| No. | Parts Name | Parts No. | Remarks | No. | Parts Name | Parts No. | Remarks |
|-----|-------------------|-------------|--|-----|-------------------|-------------|----------------------|
| 1 | Knob (push) | K29-0166-04 | POWER | 10 | Phone jack | E11-0003-05 | TONE OUT |
| 2 | Knob | K21-0816-04 | INTENSITY, FOCUS, V.GAIN SYNC/MKR, SCAN WIDTH | 11 | Push switch | S42-2503-05 | SYNC/MKR, SCAN WIDTH |
| 3 | BNC receptacle | E04-0251-05 | H.INPUT H.INPUT | 12 | Shaft | D21-0902-04 | |
| 4 | Knob | K23-0239-04 | V.ATT SWEEP RANGE | 13 | Rotary switch | S01-1506-05 | TONE |
| 5 | Knob | K21-0267-04 | FUNCTION, RFATT, TONE | 14 | Variable resistor | R05-8501-05 | FOCUS, INTENSITY |
| 6 | Knob (push) | K21-0817-04 | SYNC/MKR, SCAN WIDTH | 15 | Power switch | S39-2006-05 | POWER |
| 7 | Eschtcheon (push) | B07-0702-04 | | 16 | Lamp ass'y | B30-0907-05 | |
| 8 | Panel ass'y | A20-2724-03 | | 17 | Switch fittings | | |
| 9 | Switch fittings | | | 18 | GND lug | E23-0015-04 | |

SECTION 10. DISASSEMBLY

1. GRATICULE REMOVAL/INSTALLATION

Press at Fig. 10-3 arrows, and withdraw upward and out.

To reinstall, insert the bottom edge of the graticule between the front panel and the CRT, and then direct the top edge in toward the CRT.

2. CRT REMOVAL

- 1) Remove screws "A".
- 2) Loosen screws "B" and remove the CRT socket.
- 3) Shift the CRT to the rear arrow, and then withdraw the CRT and its fittings upward and out.

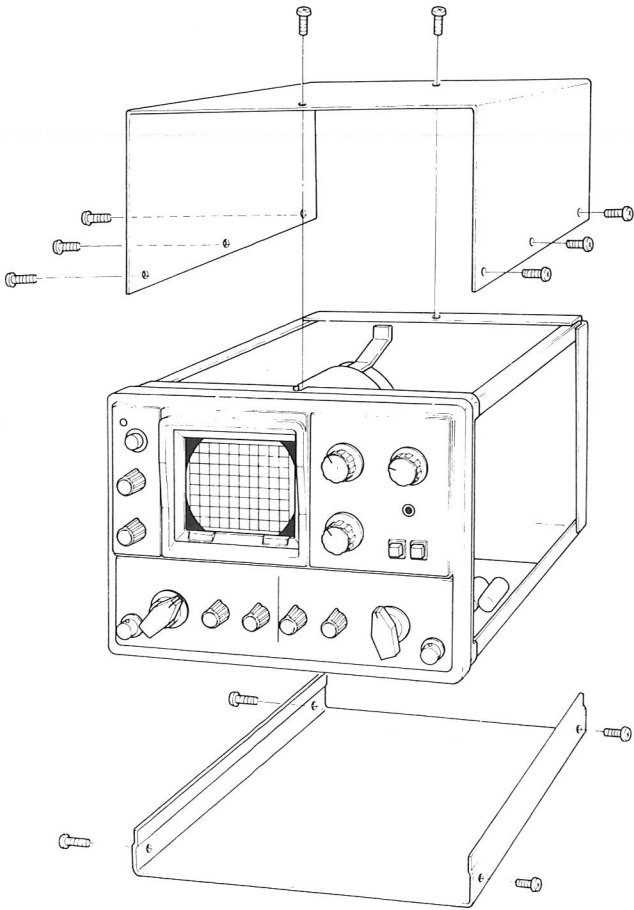


Fig. 10-2 Case Removal

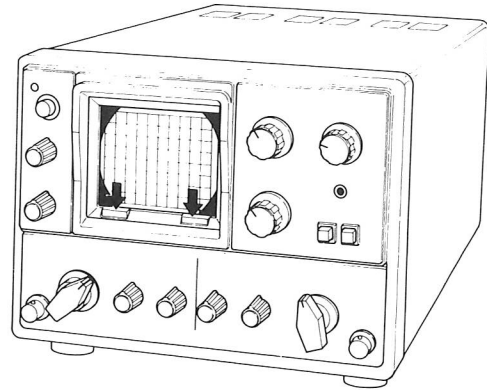


Fig. 10-3 Graticule Removal/Installation

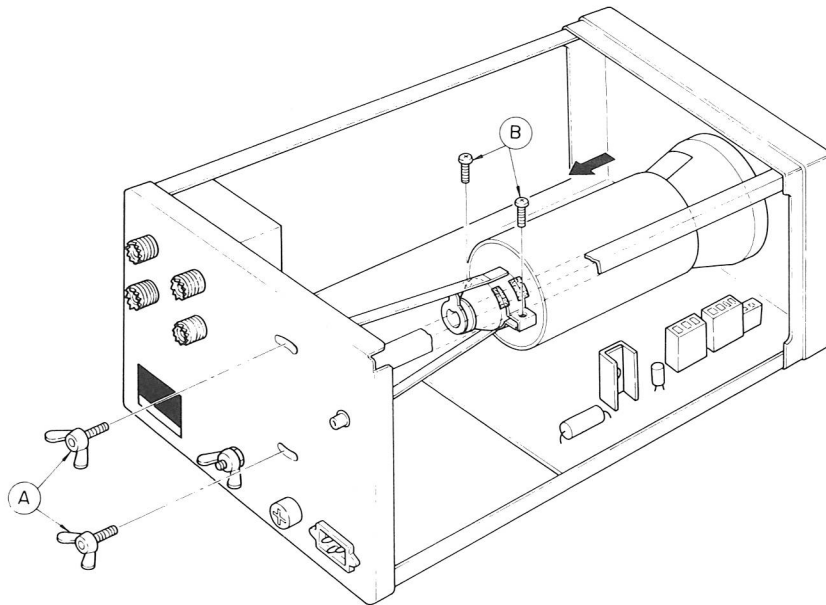


Fig. 10-4 CRT Removal

SECTION 11. ADJUSTMENT

● Test Equipment Required

1. AC (Audio Generator)

Sine and squarewave generator than 5V at 1KHz.

2. AF VTVM

Range: 10 mV ~ 10V

3. HF-SG (Signal Generator)

Output 100 KHz and 12 MHz.

4. Oscilloscope

Frequency response generator 5 MHz, 20 mV sensitivity.

NOTE: SM-220 itself can be used.

● Adjustment Procedure

(Adjustments are shown in Fig. 11-1)

1. DC Balance VR-101

(Adjustable from the bottom of the case)

If vertical amplifier DC balance is not maintained, the trace or waveform will shift vertically when the V. GAIN is adjusted.

- 1) Place the V. ATT to GND/MONITOR and adjust the V. GAIN fully counterclockwise. Adjust the \blacklozenge Position so the trace is centered.
- 2) Adjust the GAIN fully clockwise. Adjust the DC Bal VR101 until the trace returns to the screen center.
- 3) Repeat this procedure two or three times until the trace remains stationary when the V. GAIN is adjusted.

NOTE: Perform this procedure after the unit stabilites, about 15 minutes.

2. Horizontal Gain VR-106

Place the SWEEP RANGE control in the 10—100 Hz position. If the trace does not fully extend over the screen, adjust the HOR. GAIN VR-106 as follows.

- 1) Place the SWEEP RANGE control in the RTTY/EXT position and turn the SWEEP VAR/EXT GAIN control fully clockwise.
- 2) Apply a 1 kHz, 3V signal to the H. INPUT/EXT SYNC terminal. Adjust VR-106 for a trace length of 10 divs.

3. Vertical Attenuator (V. ATT) Frequency Response

- 1) Apply a 1 kHz square wave at approximately 50 mV, to the V. INPUT terminal. Set the V. ATT to 1 and the SWEEP RANGE to 100—1 kHz. Adjust the V. GAIN and SWEEP VARI/EXT GAIN for square wave amplitude of approximately 6 divs, and 2 ~ 4 cycles displayed. Check that the ideal waveform (as shown in Fig. 11-2) is displayed.

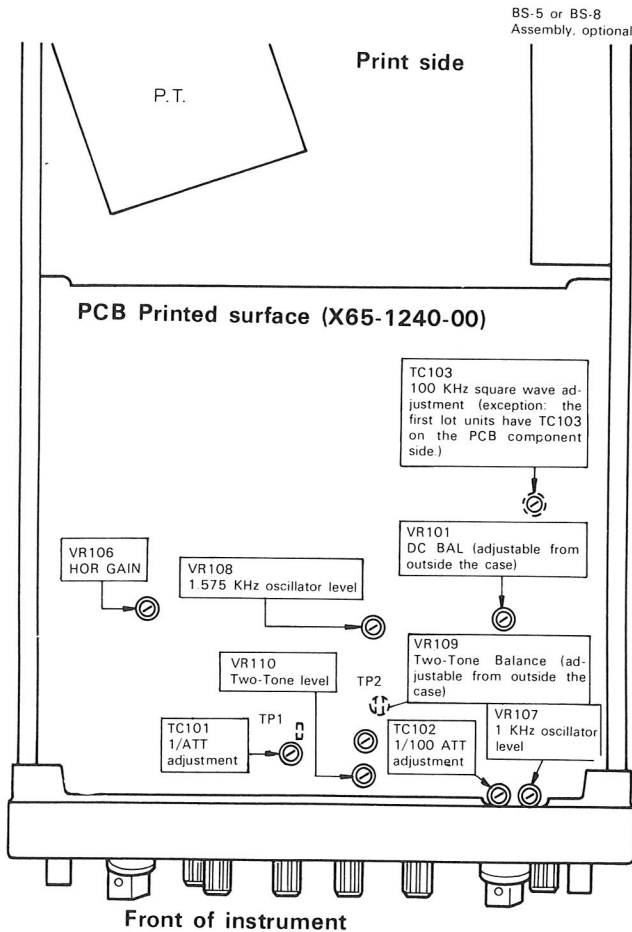


Fig. 11-1 Adjustment

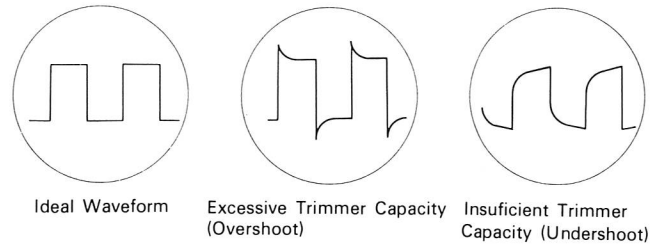


Fig. 11-2 V. ATT High-Frequency Response Compensation

SECTION 11. ADJUSTMENT

- 2) Set the V. ATT to 1/10 and increase the AG output level by 20 dB. Adjust TC101 for ideal waveform.
- 3) Set the V. ATT to 1/100 and increase the AG output level by 20 dB. Adjust TC102 for ideal waveform. Fig. 11-2 shows the relationship between waveform and trimmer capacity.

4. High-Frequency Response Adjustment

If high-frequency response is not adjusted properly, peaks may appear around 5 ~ 10 MHz, or gain may drop off at high-frequency.

- 1) Set the V. ATT to 1, V. GAIN fully clockwise, and SWEEP RANGE to 10—100 KHz. Apply an unmodulated 100 KHz signal at ± 90 dB (.35V) to the V. INPUT terminal. Adjust the SG output level for a 6 div. display.
- 2) Change the SG output frequency to 12 MHz and adjust TC103 for a 4.2 div display.

5. Tone Oscillator Levels

(1) VR107, VR108

Place the TONE switch in the 1000 Hz position. Adjust VR107 for 3Vp-p (1V rms) at (test point) TP1. Then, place the TONE switch in the 1575 Hz position and adjust VR108 for 3Vp-p (WRMS) at TP2.

(2) Two-Tone Balance VR109

Adjust VR109 (Tone Balance) for equal output is at both the 1000 Hz and 1575 Hz switch settings, measured at the TONE OUTPUT terminal (± 7.5 mV each tone setting).

(3) Tone Output VR110

Adjust VR110 (Output Level) for 10 mV in the TWO-TONE mode, measured at the TONE OUTPUT terminal.

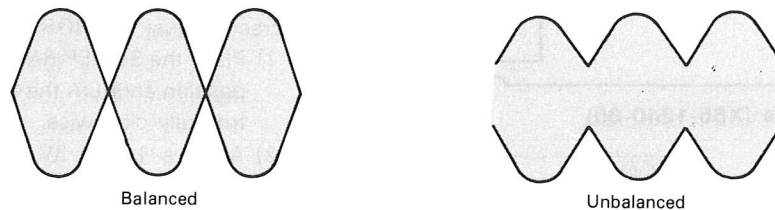
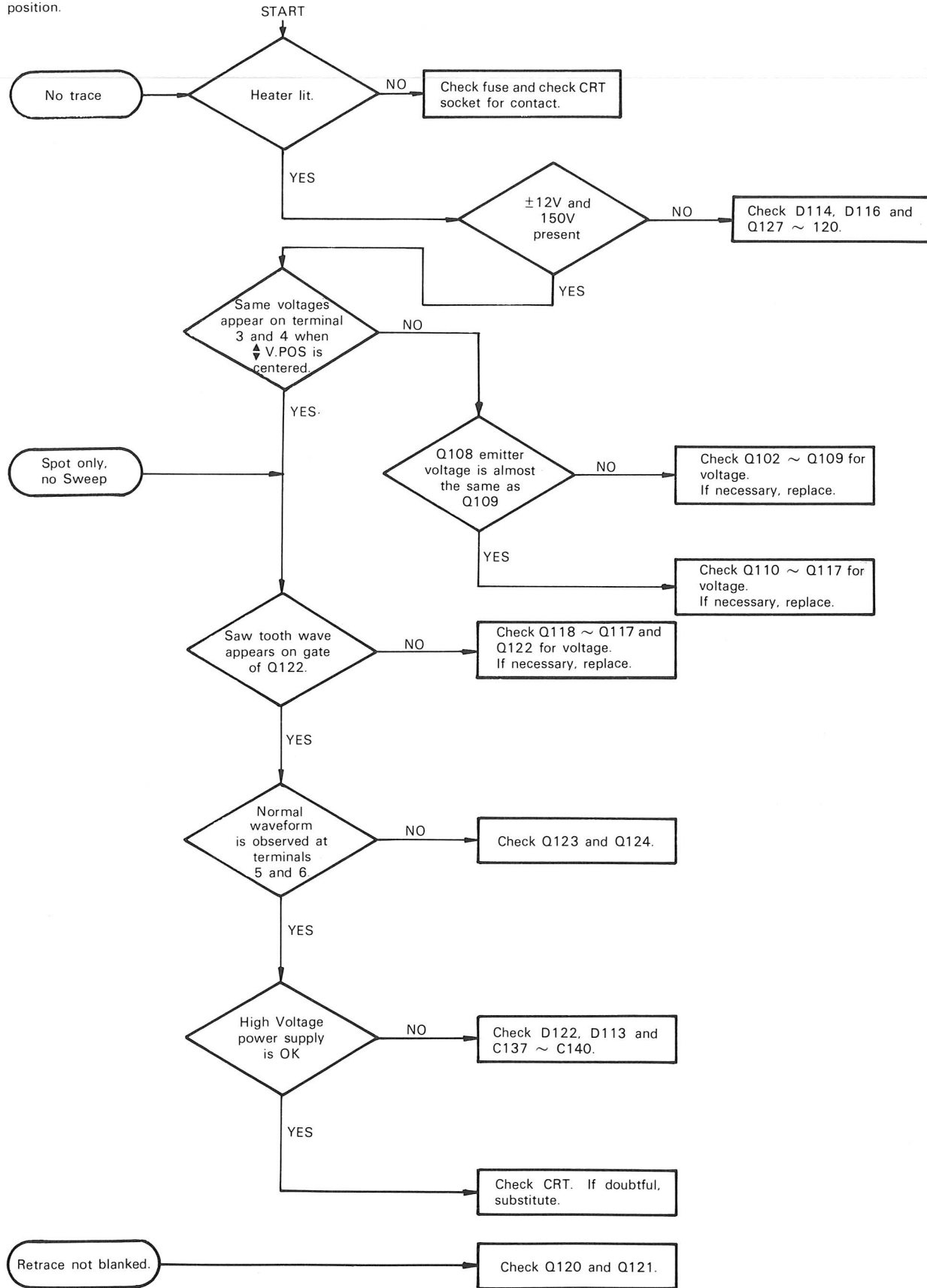


Fig. 11-3 Two-Tone Oscillator Balance Adjustment

SECTION 12. TROUBLESHOOTING

Turn the power switch On and place the Function Switch in the Oscilloscope position.



SECTION 13. PAN DISPLAY OPTION

GENERAL

To monitor signal conditions in the vicinity of your receive frequency, a Pan Display Plug-In is available as an option to the SM-220.

TS-520S series BS-5

TS-820S series BS-8

The BS-5 is designed to match the TS-520 series IF frequency 3395 KHz, and the BS-8 the TS-820 series IF frequency 8833 KHz.

When using either the BS-5 or BS-8, a minor wiring addition is required in the transceiver.

The Pan Display is easily installed in the SM-220, and requires no soldering-A11 connections are accomplished by multiconnectors.

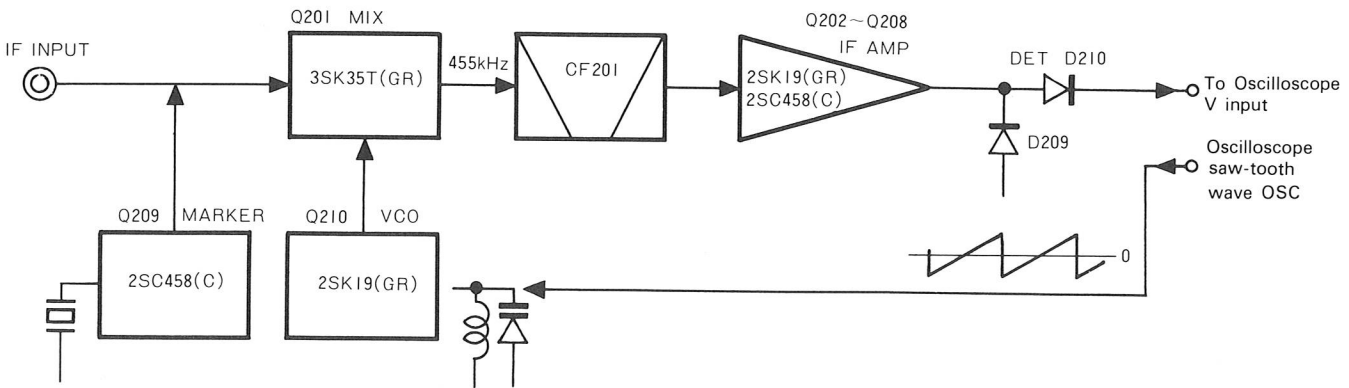
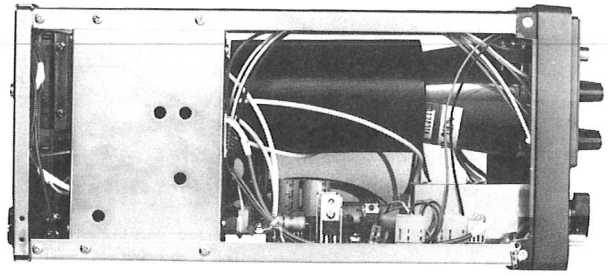


Fig. 13-1 Block Diagram

DESCRIPTION OF THE BS-5 AND BS-8

When the BS-5 or BS-8 is installed in the SM-220 and connected to the transceiver, signal conditions in the vicinity of the receive frequency can be displayed over a ± 20 KHz or ± 100 KHz range. The Pan Display amplifier employs a logarithmic compression system, so weak and strong signals can be monitored simultaneously. The narrow bandwidth filter permits monitoring of adjacent signals even under adverse receiving conditions, in both SSB and CW modes.

| | |
|----------------------|---|
| Model | FX-1082 |
| Center Frequency | 455 kHz |
| Insertion Loss | 7 dB \pm 1 dB |
| Band Width | More than 1.0 kHz/ -6 dB Less than 3.0 kHz/ -60 dB |
| Guaranty Attenuation | More than 60 dB at 455 \pm 100 kHz |

CERAMIC FILTER RATINGS

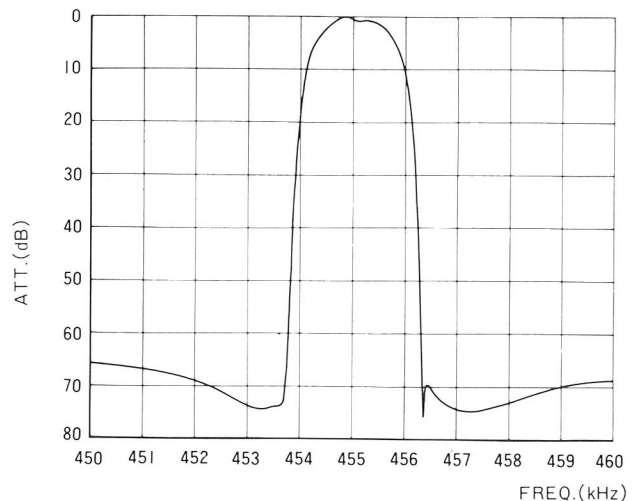
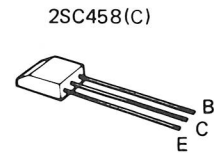
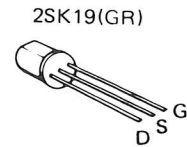
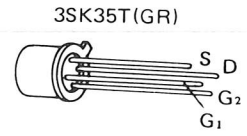
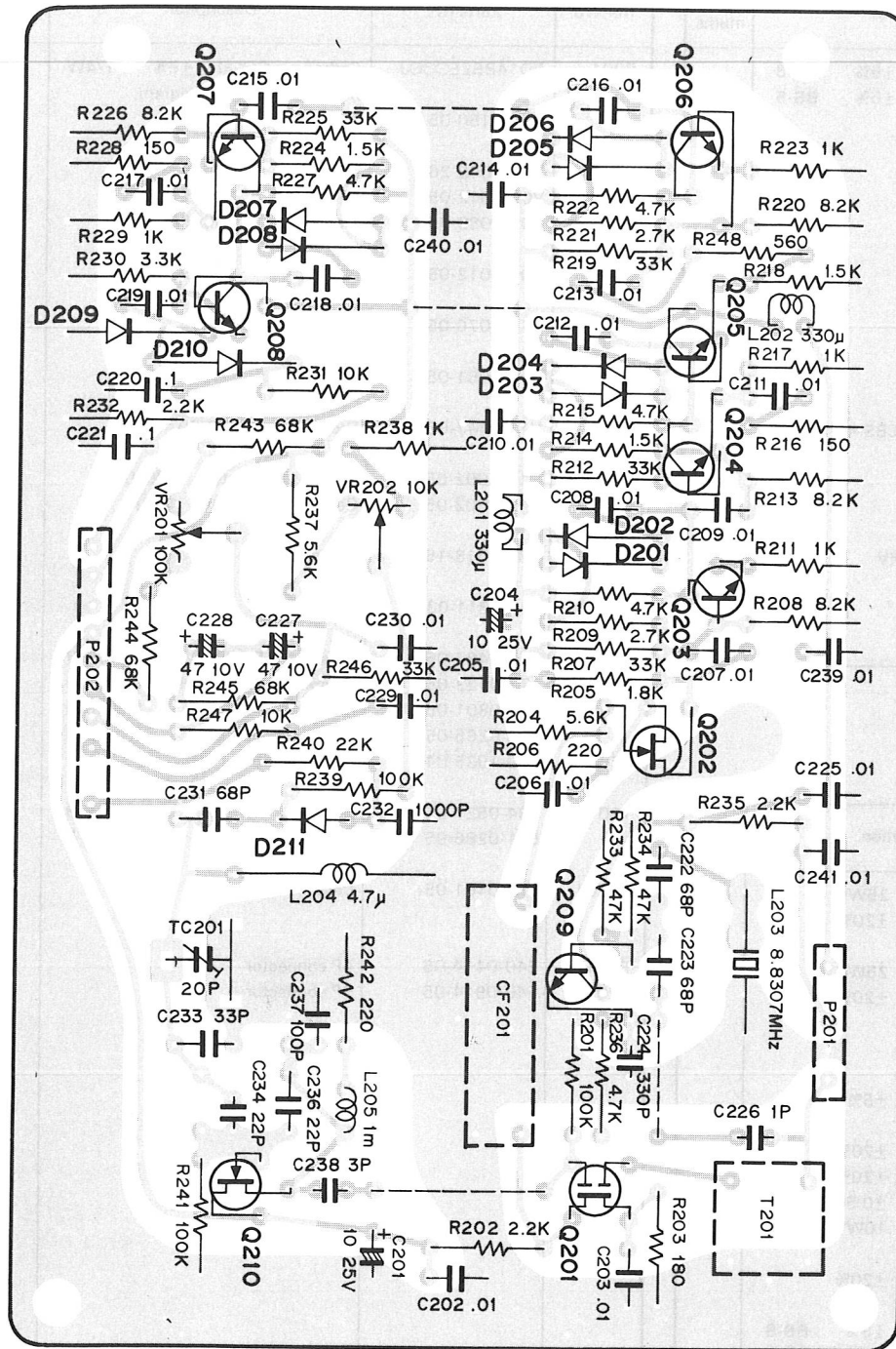


Fig. 13-2 Ceramic Filter Frequency Characteristics

PC BOARD



BS-8 UNIT (X65-1250-00)
BS-5 UNIT (X65-1250-01)

COMPARATIVE TABLE

Refer to Parts List and Schematic Diagram.

| | C231 | C232 | C233 | C234 | C236 | C237 | L203 | L204 | T201 |
|------|--------|--------|------|-------|------|-------|-----------|-------|-------------|
| BS-8 | 68pF | 1000pF | 33pF | 22pF | 22pF | 100pF | 8.8307MHz | 4.7μH | L34-0527-05 |
| BS-5 | 1000pF | 0.01μF | — | 100pF | 47pF | 680pF | 3.395MHz | 20μH | L31-0286-05 |

PARTS LIST

GENERAL

☆ : New parts

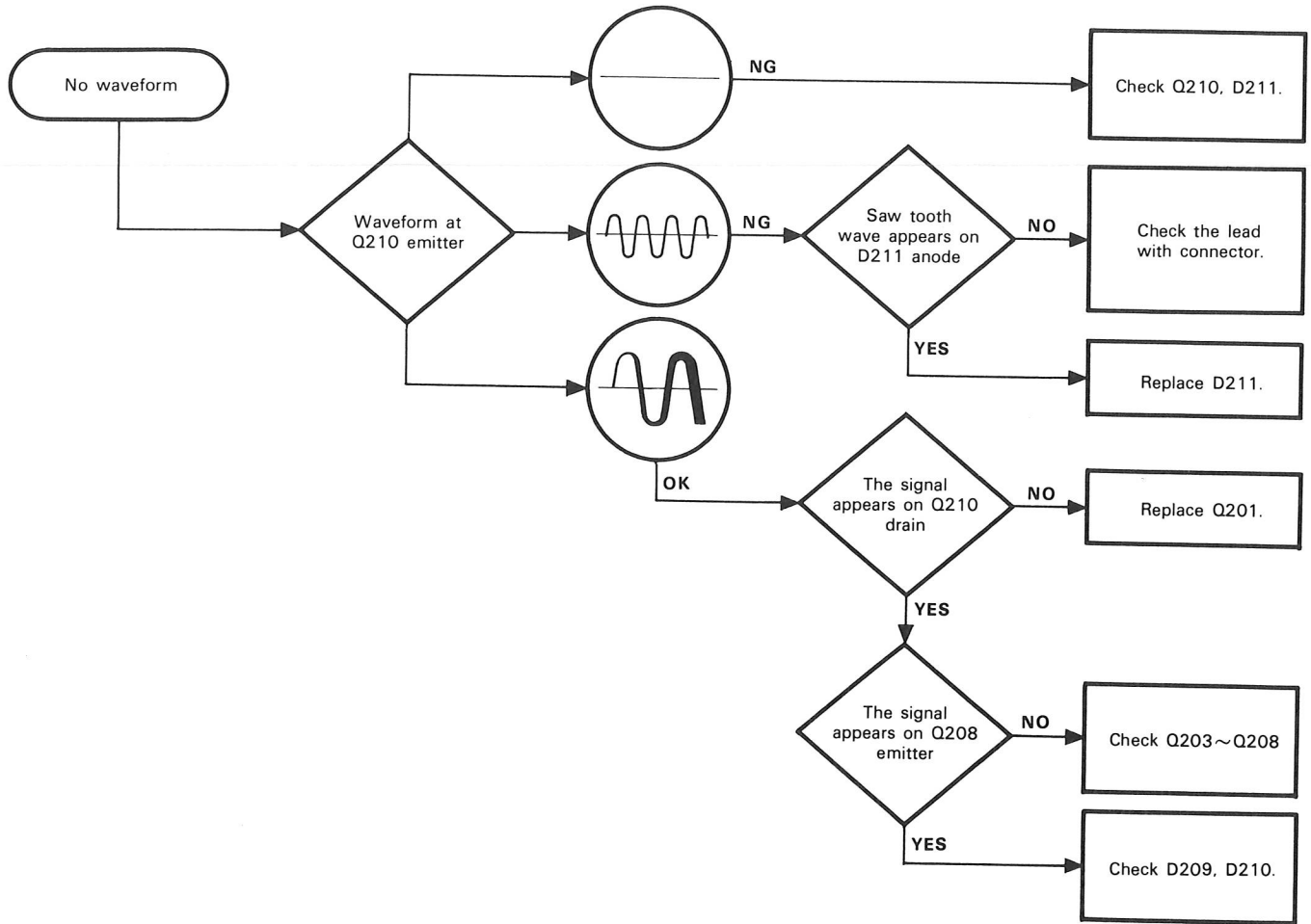
| Ref. No. | Parts No. | Description | Re- marks |
|----------|--------------|--------------------------|---------------|
| — | CC45SL1H470J | Ceramic 47pF ±5% | BS-8 |
| — | CC45SL1H101J | Ceramic 100pF ±5% | BS-5 |
| — | B20-0909-04 | Graticule | ☆ |
| — | B58-0903-00 | Caution card | ☆ |
| — | E30-1828-05 | Cord with pin plug | ☆ |
| — | E31-0573-05 | Lead with connector | ☆ |
| — | H01-2842-03 | Carton case | BS-8 ☆ |
| — | H01-2844-03 | Carton case | BS-8 ☆ |
| — | H25-0016-00 | Polyethylene bag | |
| — | H25-0029-04 | Polyethylene bag | |
| — | J61-0053-05 | Board support × 4 LCBS-4 | |
| — | N35-3006-46 | Bind screw × 8 | |
| — | 001-0801-05 | Plated lead × 5 | BS-8 |
| — | 060-3001-05 | Coaxial cable 1.5D-XV | |
| — | X65-1250-00 | BS-8 unit | BS-8 ☆ |
| — | X65-1250-01 | BS-5 unit | BS-5 ☆ |

BS-8 UNIT (X65-1250-00) BS-5 UNIT (X65-1250-01)

| Ref. No. | Parts No. | Description | Re- marks |
|-----------|--------------|------------------------|--------------|
| C201 | CE04W1E100 | Electrolytic 10μF 25WV | |
| C202, 203 | CK45D1H103M | Ceramic 0.01μF ±20% | |
| C204 | CE04W1E100 | Electrolytic 10μF 25WV | |
| C205~219 | CK45D1H103M | Ceramic 0.01μF ±20% | |
| C220, 221 | C90-0298-05 | Ceramic 0.01μF | |
| C222, 223 | CC45SL1H680J | Ceramic 68pF ±5% | |
| C224 | CK45D1H331M | Ceramic 330pF ±20% | |
| C225 | CK45D1H103M | Ceramic 0.01μF ±20% | |
| C226 | CC45SL1H010D | Ceramic 1pF ±0.5pF | |
| C227, 228 | CE04W1A470 | Electrolytic 47μF 10WV | |
| C229, 230 | CE45D1H103M | Ceramic 0.01μF ±20% | |
| C231 | CC45CH1H680J | Ceramic 680pF ±5% | BS-8 |
| | CK45D1H102M | Ceramic 1000pF ±20% | BS-5 |
| C232 | CK45D1H102M | Ceramic 1000pF ±20% | BS-8 |
| | CK45D1H103M | Ceramic 0.01μF ±20% | BS-5 |
| C233 | CC45CH1H330J | Ceramic 33pF ±5% | BS-8 |
| | | | BS-5 |
| C234 | CC45CH1H220J | Ceramic 22pF ±5% | BS-8 |
| | CC45CH1H101J | Ceramic 100pF ±5% | BS-5 |
| C235 | | | |
| C236 | CC45CH1H220J | Ceramic 22pF ±5% | BS-8 |
| | CC45CH1H470J | Ceramic 47pF ±5% | BS-5 |
| C237 | CC45CH1H101J | Ceramic 100pF ±20% | BS-8 |
| | CK45D1H681M | Ceramic 680pF ±20% | BS-5 |
| C238 | CC45SL1H030D | Ceramic 3pF ±0.5pF | |
| C239~241 | CK45D1H103M | Ceramic 0.01μF ±20% | |

| Ref. No. | Parts No. | Description | Re- marks |
|-----------|--------------|--|--------------|
| R201~ | RD14BB2E000J | Carbon 〇〇〇Ω ±5% 1/4W | |
| — | R92-0150-05 | Refer to schematic diagram. Jumper resistor × 4 | |
| Q201 | V09-1002-26 | FET 3SK35(T)(GR) | |
| Q202 | V09-0012-05 | FET 2SK19(GR) | |
| Q203~209 | V09-0080-05 | Transistor 2SC458(C) | |
| Q210 | V09-0012-05 | FET 2SK19(GR) | |
| D201~208 | V11-0076-05 | Diode 1S555 | |
| D209, 210 | V11-0051-05 | Diode 1N60 | |
| D211 | V11-0447-05 | Diode 1SV50 | |
| VR201 | R12-5002-05 | Semi-fixed resistor 100kΩ | |
| VR202 | R12-3002-05 | Semi-fixed resistor 10kΩ | |
| TC201 | C05-0013-15 | Trimmer 20pF | |
| L201, 202 | L40-3311-03 | Ferri-inductor 330μH | |
| L203 | L77-0487-05 | Crystal 8.8307 MHz | BS-8 |
| | L77-0123-05 | Crystal 3.395 MHz | BS-5 |
| L204 | L33-0801-05 | Choke coil 4.7μH | BS-8 |
| | L33-0265-05 | Choke coil 20μH | BS-5 |
| L205 | L40-1025-04 | Ferri-inductor 1 mH | |
| T201 | L34-0527-05 | IFT | BS-8 |
| | L31-0286-05 | IFT | BS-5 |
| CF201 | L72-0401-05 | Ceramic filter | |
| P201 | E40-0414-05 | 4P connector | |
| P202 | E40-0914-05 | 9P connector | |

TROUBLE SHOOTING/INSTALLATION



ADJUSTMENTS/PACKING

INSTALLATION

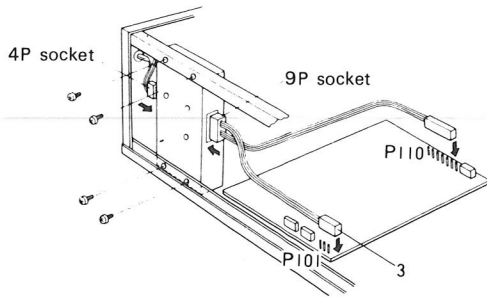


Fig. 13-3 BS-5, BS-8 Installation

ADJUSTMENT

The BS-5 or BS-8 must be adjusted before use. For adjustment, the antenna must be disconnected from the transceiver.

1. Set the SM-220 FUNCTION switch to BAND SCOPE (Pan Display).
2. Depress the MARKER switch ON, center the display by the ◀▶ POSITION control and center the V. GAIN control. Adjust the ▲ POSITION to shift the trace to the bottom of the graticule. With the SCAN WIDTH set to the WIDE 100 KHz position, turn the scan width adjustment VR202 until the marker signal moves to the scope center line.
3. Turn the MARKER OFF. Set the transceiver RF GAIN to MAX, and the FUNCTION switch to CAL 25 KHz and peak the drive control for MAX "S" meter reading. At this time, check that 8-10 waveform peaks ("SPIKES") appear on the CRT screen, as shown in Fig. 13-5B. If necessary, reset the center frequency adjustment trimmer TC201 and the scan width adjustment VR202 (STEP2), until the waveform shown in Fig. 13-5A is obtained.

NOTE: Make certain you have actually adjusted the center frequency to the receiver. If necessary, find a single signal to verify this adjustments

4. Turn off the 25 KHz calibrator, turn on the marker. Set the SCAN WIDTH to the NARROW (20 KHz) position, and adjust VR201 for CENTERED marker display, as previously outlined is step 2.

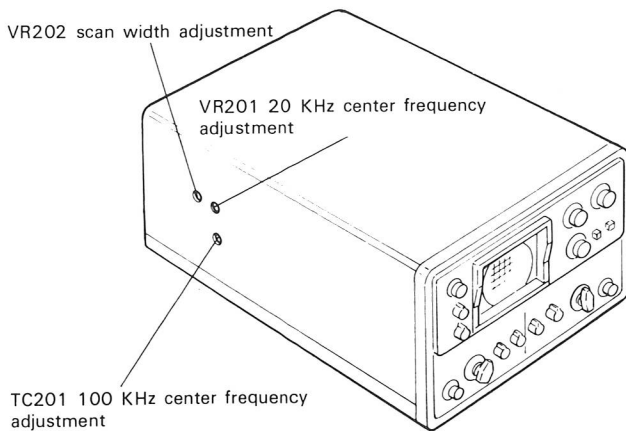


Fig. 13-4 Pan Display Adjustment

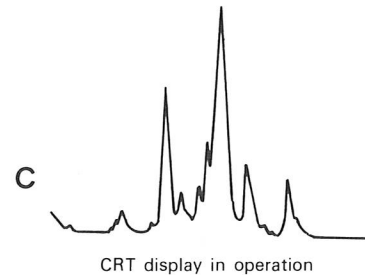
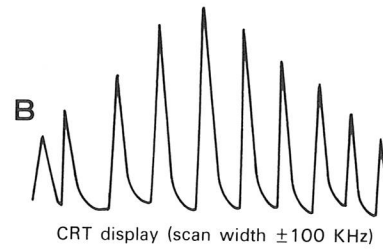
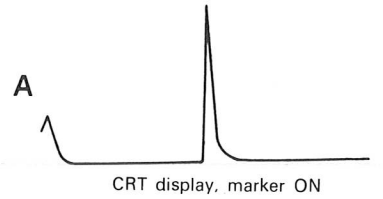
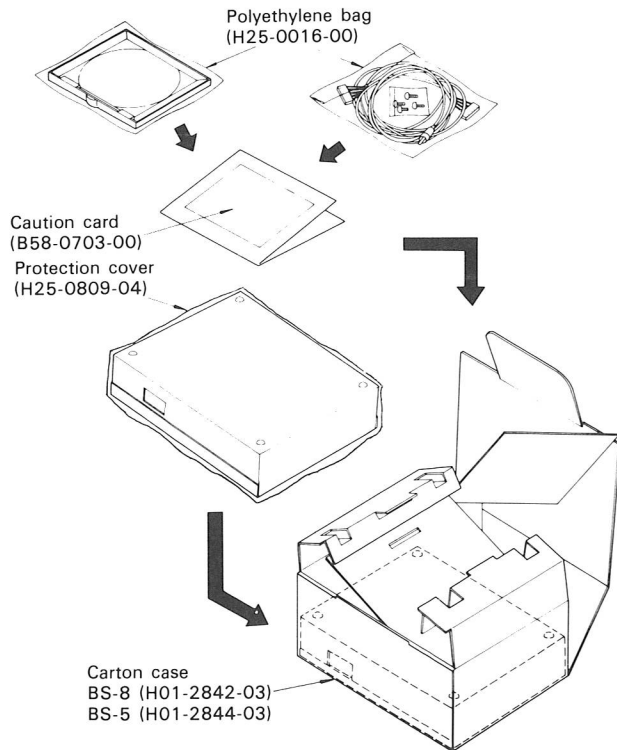


Fig. 13-5 Pan Display Waveforms

PACKING

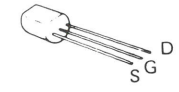


ACCESSORIES

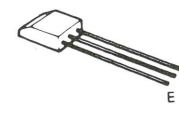
- Caution card (B58-0703-00)
- Graticule (B20-0909-04)
- Cord with pin plug (E30-1828-05)
- Lead with connector (E31-0573-05)
- Bind screw × 4 (N35-3006-46)
- Pick-up cord (060-3001-05)

SECTION 14. SCHEMATIC DIAGRAM

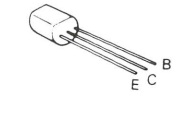
2SK30A(O)
2SK30A(O)(IDSS)
2SK30A(GR)



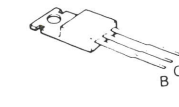
2SC535(B)



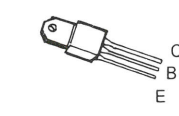
2SC1360



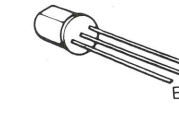
2SC1419C
2SA755C
2SC1569



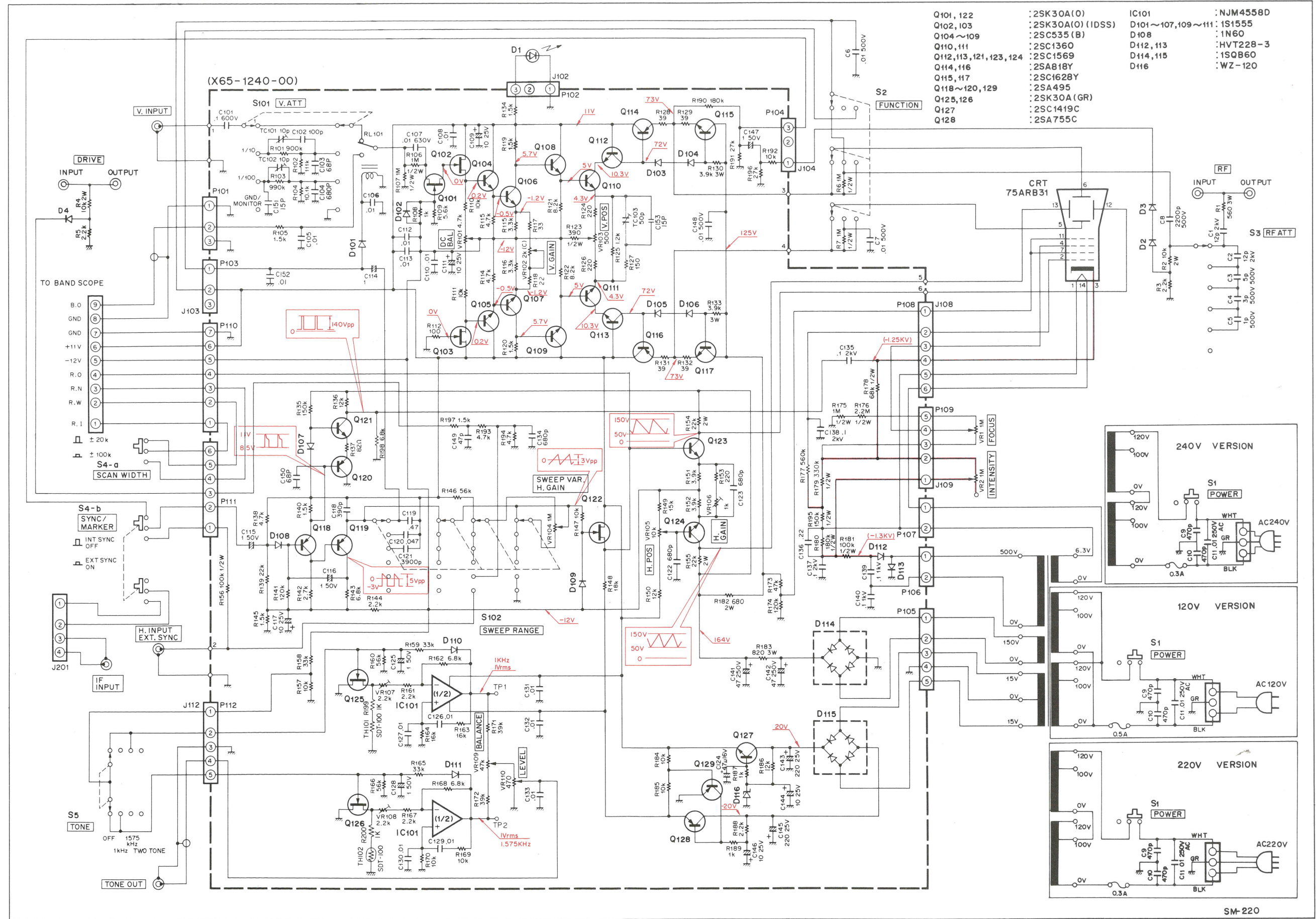
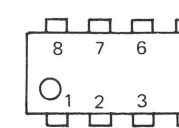
2SA818Y
2SC1628Y



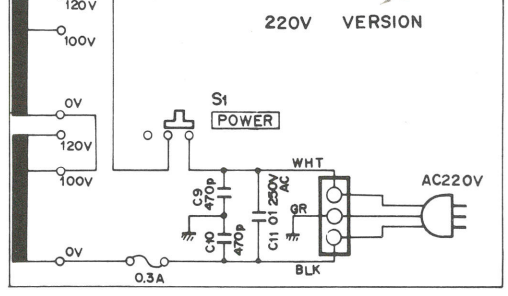
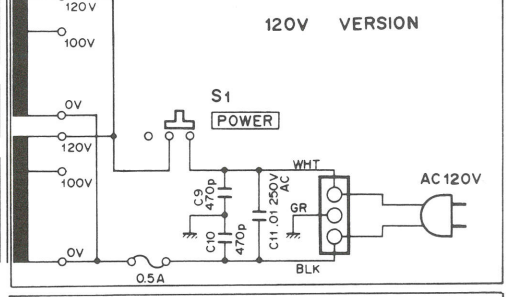
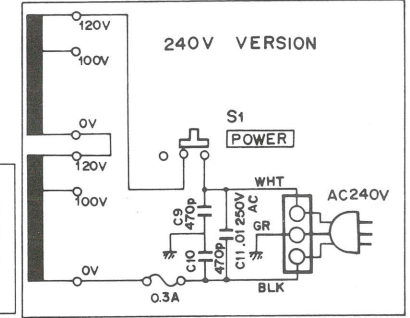
2SA495



NJM4558D

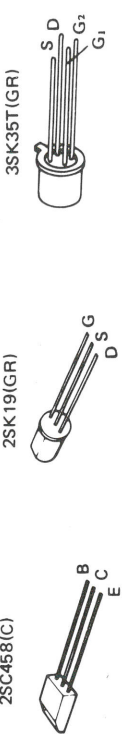
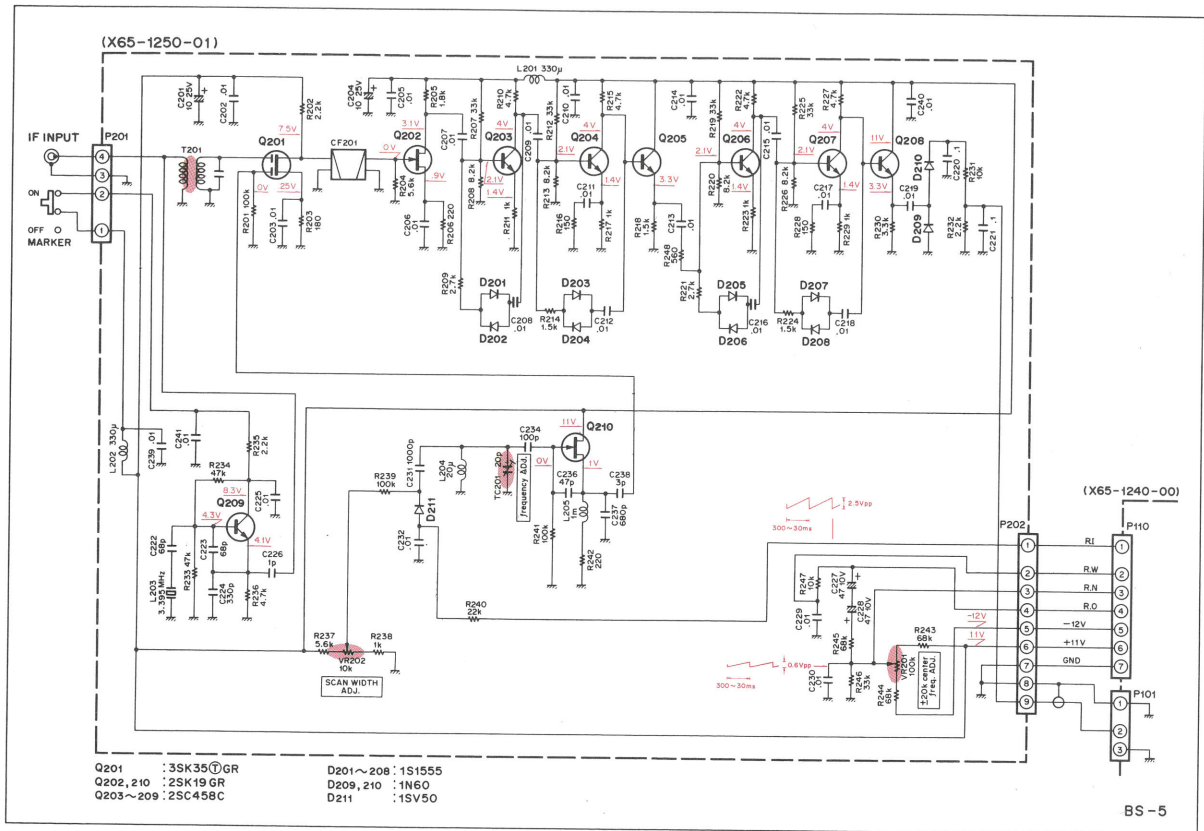


| | | | |
|--------------------------|-------------------|------------------|------------|
| Q101, 122 | : 2SK30A(O) | IC101 | : NJM4558D |
| Q102, 103 | : 2SK30A(O)(IDSS) | D101~107,109~111 | : 1S1555 |
| Q104~109 | : 2SC535(B) | D108 | : 1N60 |
| Q110, 111 | : 2SC1360 | D112, 113 | : HVT22B-3 |
| Q112, 113, 121, 123, 124 | : 2SC1569 | D114, 115 | : 1SQB60 |
| Q114, 116 | : 2SA818Y | D116 | : WZ-120 |
| Q115, 117 | : 2SC1628Y | | |
| Q118~120, 129 | : 2SA495 | | |
| Q125, 126 | : 2SK30A(GR) | | |
| Q127 | : 2SC1419C | | |
| Q128 | : 2SA755C | | |

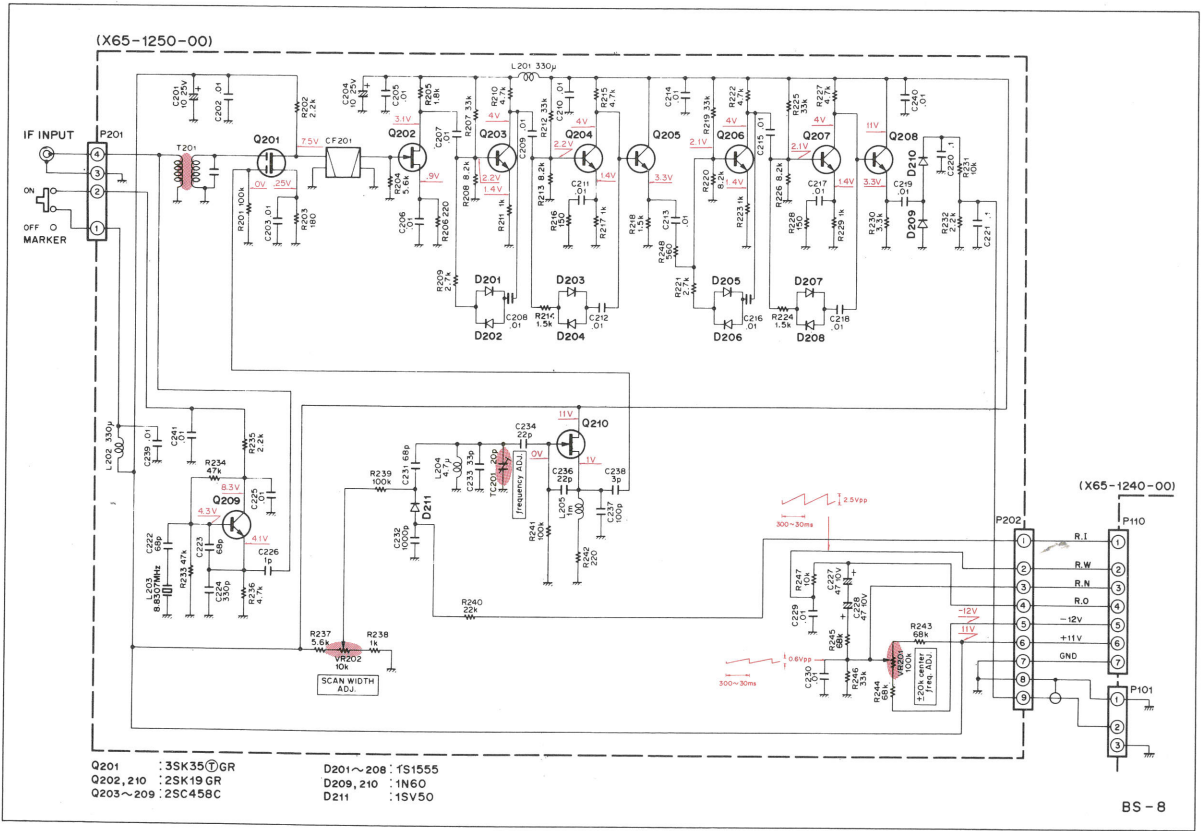


SM-220

BS-5 SCHEMATIC DIAGRAM



BS-8 SCHEMATIC DIAGRAM



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